APPENDIX A

Record of Decision

Prepared by EPA Region IV for the

Florida Petroleum Reprocessors Site

DAVIE, FLORIDA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

March 2001

Record of Decision

Prepared by EPA Region IV

for the

Florida Petroleum Reprocessors Site

Davie, Florida

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Record of Decision Declaration

SITE NAME AND LOCATION

Florida Petroleum Reprocessors
Davie, Broward County, Florida

STATEMENT AND BASIS OF PURPOSE

This decision document presents the selected remedial action for the Florida Petroleum Reprocessors Superfund Site, located in Davie, Florida, developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA) and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for this Site.

The State of Florida Department of Environmental Protection (FDEP) has been consulted during the development of the selected remedy and is expected to concur with this decision.

ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) is necessary to protect the public health, welfare, or the environment from actual or threatened releases of hazardous substance into the environment.

DESCRIPTION OF THE REMEDY

This remedy is intended to be the first and final operable unit for this Site. The purpose of this remedy is to prevent potential exposures to groundwater contamination at the Site, to prevent the further migration of contaminants within the Biscayne aquifer groundwater, and to reduce groundwater contaminant levels to comply with federal and state drinking water standards. This remedy will address the large plume of groundwater contamination that has migrated northward from this facility through the pumping, treating, and disposal of contaminated groundwater at the facility, monitored natural attenuation of less contaminated portions of the plume, and protection of the Peele-Dixie Wellfield.

Major Components of the selected remedy include:

- Collection of contaminated groundwater via extraction wells
- Treatment of contaminated groundwater via air stripping and activated carbon
- Monitored natural attenuation of groundwater
- Peele-Dixie Wellfield protection
- Long-term groundwater monitoring of groundwater.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, and complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this Site and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Although this remedy will reduce hazardous substances in on-Site soils to below health-based standards, contaminants in groundwater will not be reduced to below health-based standards for an extended period of time. Therefore, a review will be conducted within 5 years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record for this Site.

- Chemicals of concern and their respective concentrations
- Baseline risks represented by the chemicals of concern
- Cleanup levels established for chemicals of concern and the basis for these levels
- How source materials constituting principal threats are addressed
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD
- Potential land and groundwater use that will be available at the Site as a result of the Selected Remedy
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rates, and the number of years over which the remedy cost estimates are projected
- Key factors that led to selecting the remedy (i.e., how the Selected Remedy provides the best balance of trade-offs with respect to the balancing and modifying criteria).

AUTHORIZING SIGNATURES

Pursuant to Section 104 of CERCLA, the President is authorized to undertake actions in response to a threat or potential threat to human health, welfare, or the environment. This authority was delegated to the Administrator of the U.S. Environmental Protection Agency, then to the Regional Administrators, and through other delegations, the regional Division Directors of the Superfund program are now authorized to approve these actions.

1 MAR '01

Richard D. Green, Director
Waste Management Division

Date

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List of Acronyms

AR	Administrative Record
ARAR	applicable or relevant and appropriate requirement
Bechtel	Bechtel Environmental, Inc.
bgs	below ground surface
BRA	baseline risk assessment
BTEX	benzene, toluene, ethyl benzene, and xylene
CAR	contaminant assessment report
CFR	Code of Federal Regulations
COPC	chemical of potential concern
DCA	dichloroethane
DCE	dichloroethene
DNAPL	dense nonaqueous-phase liquid
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulations
FDOT	Florida Department of Transportation
FPR	Florida Petroleum Reprocessors
FS	feasibility study
FSA	feasibility study addendum
ft/day	foot/feet per day
HHRA	human health risk assessment
HI	hazard index
I-595	Interstate 595
INEEL	Idaho National Engineering and Environmental Laboratory
LNAPL	light nonaqueous-phase liquid
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
MCL	maximum contaminant level
mgd	million gallons per day

MNA	monitored natural attenuation
NCP	National Contingency Plan
NUS	NUS Corporation
OCI	Oil Conservationist, Inc.
O&M	operations and maintenance
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	perchloroethene
Perma-Fix	Perma-Fix Environmental Services
PMI	Petroleum Management, Inc.
PRP	potentially responsible party
RAO	remedial action objective
RI	remedial investigation
ROD	Record of Decision
SFWMD	South Florida Water Management District
SVOC	semivolatile organic compound
TCA	trichloroethane
TCE	trichloroethene
TPH	total petroleum hydrocarbons
TRV	toxicity reference value
VOC	volatile organic compound
yd^3	cubic yard

Decision Summary

1.0 SITE BACKGROUND

1.1 Location and Description

The Florida Petroleum Reprocessors (FPR) Superfund Site[1] is located at 3211 SW 50th Avenue in Davie, Florida (Figure 1-1). Waste oil recycling operations were conducted under various names from 1977 to 1992. The Site is located in an area formerly known as Old Hacienda Village, but has since been incorporated into the western portion of the Town of Davie. The facility is approximately 1 acre in size and is located in an industrial park immediately east of the Florida Turnpike, and approximately 0.5 mile south of Interstate 595 (I-595). The Site encompasses an area of approximately 870 acres, which is generally bounded to the north by Peters Road that divides the northern and southern portion of the City of Fort Lauderdale's Peele-Dixie Wellfield, to the east by U.S. Route 441, to the south by Orange Drive, and to the west by the Florida Turnpike. Geographically, the Site is located in the southeast portion of the Florida peninsula. The area is comprised of a mixture of land uses, including light industrial, commercial, and residential.

The Site overlies the highly productive Biscayne aquifer. This water-table aquifer is defined by the U.S. Environmental Protection Agency (EPA) as a sole source drinking water aquifer and is further defined by the Florida Department of Environmental Protection (FDEP) as a primary drinking water source, vulnerable to contamination, warranting a high degree of protection. The upper part of the aquifer is comprised of unconsolidated sand with intermittent lenses of limestone and sandstone. The lower portion is a dense limestone with varying degrees of solutioning. Although groundwater levels vary with rainfall, the water table is about 5 feet below ground surface (bgs).

As discussed in detail in subsequent sections of this Record of Decision (ROD), the primary threat posed by this Site is to the Biscayne aquifer and the drinking water resource that it provides to local municipalities, private utilities, and the Florida Seminole Tribe. None of these drinking water supplies are immediately threatened, but given the proximity of other drinking water supplies as shown in Figure 1-2, there are several drinking water supplies that could be potentially threatened in the future. Although private wells were historically used for drinking water, users of private wells have since been provided with municipal water. Given the Site's location in an industrial park and its lack of significant topography and drainage features, the Site does not appear to threaten any natural resources or environmentally sensitive areas. Although

[1] Pursuant to CERCLA, a site is defined not only as where hazardous wastes have been deposited (i.e., the facility), but also where the contaminants have come to migrate. This distinction is important at this site since, although the facility is only about 1 acre in size, contaminants have migrated in the groundwater encompassing an area over 800 acres in size. For the purposes of this Record of Decision (ROD), the term "facility" will be used to describe the FPR property, and the term "Site" will include not only the facility, but the full extent of groundwater contamination the response action is intended to address.

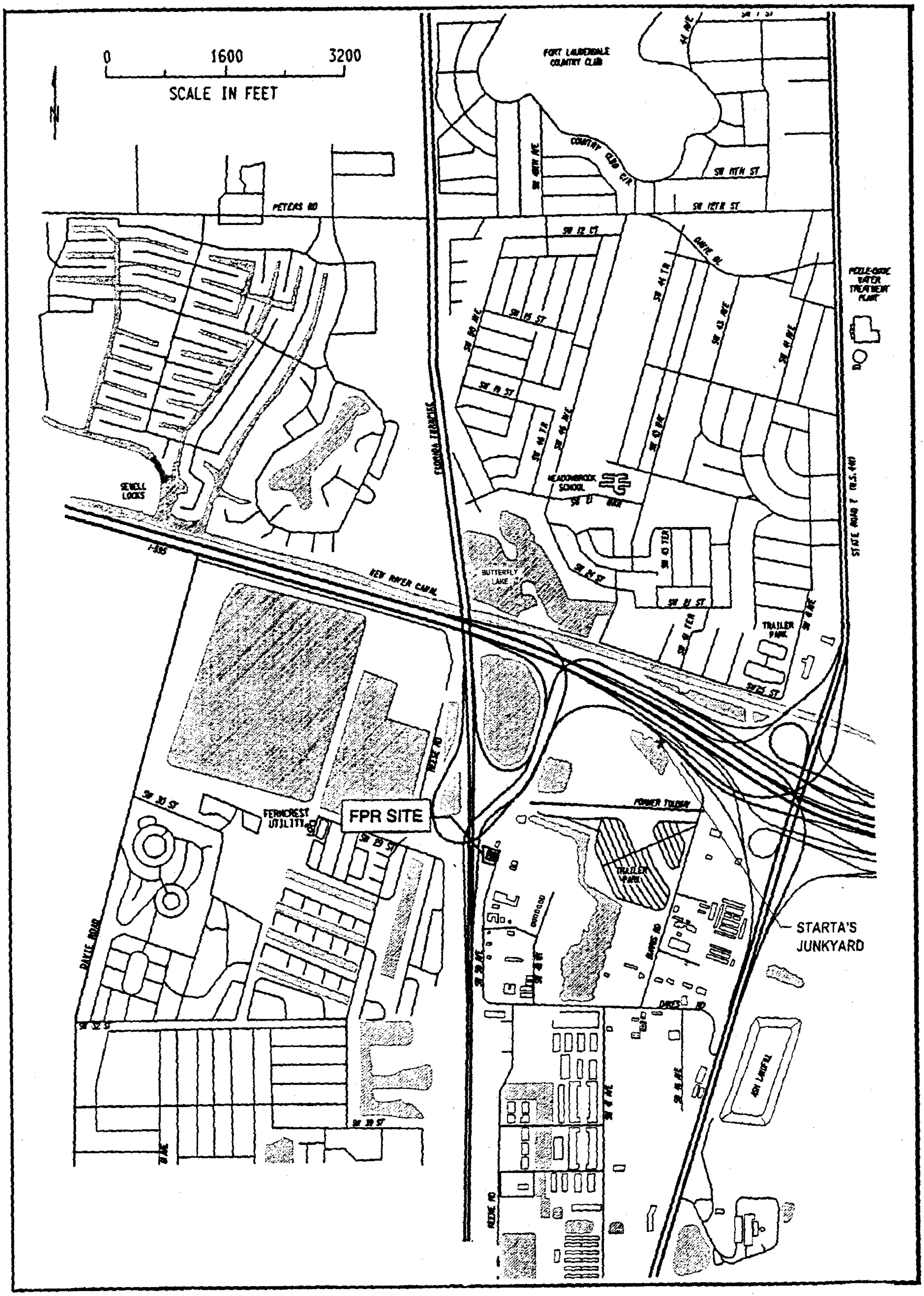
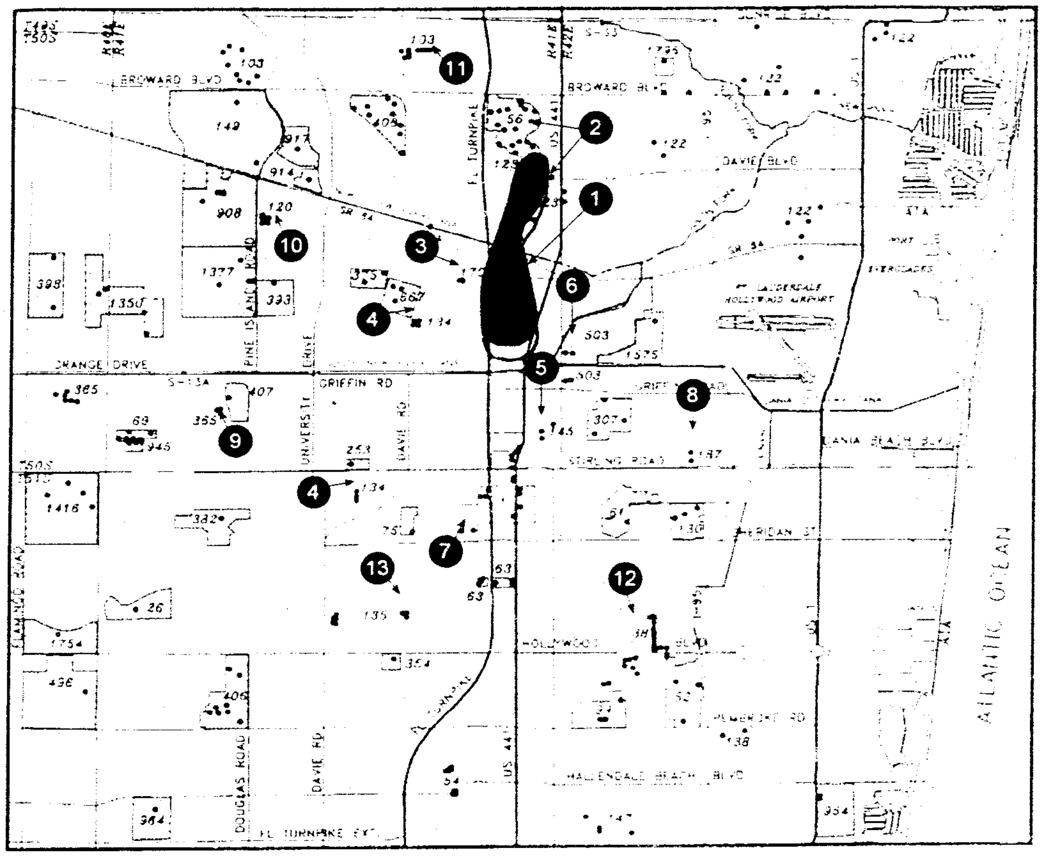


Figure 1-1
Site Location Map
Florida Petroleum Reprocessors, Davie, Florida



LEGEND

- ● Withdrawal Site
- SFWMD Permit Number (I.E. 147 IS #06-00147-W)
- Permitted Project Area
- Well Sites Without Project Area Are Public Water Supply Wellfields
- Contaminant Plume

Source: **Workplan for Seminole Hollywood Reservation, Murray Consultants Inc., July 1994**

Approximate Scale: 1" = 11,000'

MAP LOCATION	DESCRIPTION
1	FPR Contaminant Plume
2	Peele-Dixie Wellfield
3	Ferncrest Utilities Wellfield
4	Town of Davie Wellfields (North & South)
5	Broward County Wellfield 3A
6	FP&L Ft Lauderdale Power Plant Process Supply Wells
7	Seminole Tribe Hollywood Reservation Wellfield
8	City of Dania
9	Cooper City
10	City of Sunrise
11	City of Plantation
12	City of Hollywood
13	City of Pembroke Pines

Figure 1-2
Location of Nearby Wellfields
Florida Petroleum Reprocessors, Davie, Florida

there are numerous lakes and canals in the area that support various plants and wildlife, contaminants near the surface do not appear to have migrated significantly beyond the facility boundary. The discharge of contaminated groundwater to surface water does not appear to be to be a significant contaminant migration pathway.

In addition to the contaminants that have been released from the FPR facility, a second source of groundwater contamination appears to be located along the south side of I-595, and east of the Florida Turnpike. This second source is the location of a former junkyard known as Starta Sales & Salvage that operated at the location from 1965 until 1974. Motor City, Inc. continued to operate a junkyard at this location from 1974 until 1984. A Goodyear tire store opened on a portion of this location in 1979. The property was subsequently acquired by the Florida Department of Transportation (FDOT) in 1984 during the construction of I-595. Construction of this section of the Interstate did not begin until the late 1980s.

Information gained from interviews of a former owner and operator of this second source location, and long-time neighbors, indicated that approximately 1,600 junk cars had been stored on the property at one time. Junk cars were reportedly dumped into a water-filled borrow pit along the west side of the property during the operational period of Starta Sales & Salvage. According to an interview with the former owner and operator of Motor City, Inc., during the acquisition of the property for the construction of I-595, FDOT informed him of environmental problems at his property. An adequate environmental assessment or cleanup was not conducted by FDOT prior to the construction of the Interstate.

1.2 Site History and Enforcement Actions

The FPR facility is a former waste oil reprocessing facility. Operations were conducted at the facility from 1979 through 1992 under various names including Barry's Waste Oil, Oil Conservationist, Inc. (OCI), FPR, and South Florida Fuels. Operations were generally reported to include the collection of waste oil (i.e., used motor oil, surplus fuels, marine oils and slops, hydraulic oils, aviation oils, and fuels) from local automotive, agricultural, and marine industry. Incoming waste oils were generally filtered, graded according to water content, and stored on-Site in large bulk tanks. The waste oil was typically sold as fuel or to other waste oil marketers. Current records indicate that more than 15 million gallons of waste oil were processed at this facility.

Although little is known about the actual waste handling practices at the Site, studies conducted by the U.S. Environmental Protection Agency (EPA) show that former operations at the facility have resulted in the contamination of surface and subsurface soils and groundwater by oil and grease, organic chemicals common to gasoline, and chlorinated cleaning and decreasing solvents. The studies showed that contaminants were present at the Site in a concentrated form floating on top of the water table, as well as in a dispersed form mixed with the underlying groundwater. Contaminants have migrated downward from land surface to a depth of 200 feet into the aquifer. (As discussed later in this document, removal actions have been or will be completed that address much of the former shallow and deep soil and groundwater contamination.)

In 1986, solvent-related contaminants were detected by the City of Fort Lauderdale in drinking water obtained from the southern portion of the Peele-Dixie Wellfield. This prompted a series of investigations by EPA, the state, Broward County, and the city to assess the cause and extent of contamination. The contamination was originally believed to be emanating from a former dump located along 21st Manor. Steps were even taken by EPA to propose including the dump on the National Priorities List (NPL), but subsequent studies led EPA to conclude that the dump was not the source of the wellfield contamination nor did it pose a risk to nearby residents. Because of the configuration of the plume of contamination, at one time it was thought that the source of contaminants may have been within the wellfield; hence, some interim records refer to the Site as the Peele-Dixie Wellfield Groundwater Plume Site.

During the investigation of the wellfield in the early 1990s, EPA acknowledged, however, that the plume had not been fully characterized south of the wellfield. The Agency continued its study, which comprised an area about 1 square mile in size south of the wellfield. Through this investigation, EPA was able to "backtrack" a trail of contamination from the wellfield to the FPR facility. It was at this time that EPA concluded the FPR facility had impacted the wellfield and revised the Site name to the FPR Site. EPA completed the field work for the remedial investigation (RI) for the FPR Site in April 1997, and issued an RI and feasibility study (FS) report in June 1998.

Operations at the FPR facility began in 1977. The owners of the company, Barry Paul and Judd Gilbert, leased the northern portion of the property from the property owners, Charles and Hamilton Forman. Mr. Paul and Mr. Gilbert conducted business under several names, including Barry's Waste Oil Service and OCI. In 1979, the Formans sold the property to Charles and Sandra Greene, who continued to lease the northern portion to Mr. Paul and Mr. Gilbert. In 1979, the Greenes leased the southern portion of the property to R. J. Canfield, who operated an underground tank removal and disposal service under the name R. J. Canfield Environmental Contractors. In 1981, the Greenes conveyed the property to OCI, the company formed by Barry Paul.

According to the records of the Florida Department of Environmental Regulations (FDER), now known as the FDEP, storage and process tanks on the northwest portion of the facility were surrounded by an earthen dike, and an unlined pit was used as an evaporation pit for wastewater following the oil-water separation process. According to a July 1981 FDER inspection report, the area was highly contaminated with spilled oil and operations were generally sloppy. As a result of this inspection, FDER first issued a warning letter, and then a notice of violation, advising OCI to curtail activities resulting in the discharge of pollution and to initiate action to define the extent of contamination at its facility. In response, Barry Paul, through his company, OCI, undertook corrective measures. A secondary containment system was constructed and storage and process tanks were moved into the containment berm. A 4,000-gallon drop tank, which was partially buried with an open top, was installed to receive and measure shipments as they arrived at the facility. A 3,000 gallon-underground storage tank was used for the collection and storage of storm water. Both the drop tank and storm water tank were constructed outside the secondary containment area.

According to a 1983 FDER compliance report, spills around the drop tank were common and soil from that area was routinely excavated and replaced with clean fill. Between 1985 and 1987, the drop tank was removed and shipments were unloaded into tanks within the containment area. In a recent interview with EPA, Barry Paul stated that he saw holes in the drop tank after it had been removed. During this time period, all tanks in the northwest quadrant of the facility were removed. Groundwater contamination was discovered at the facility in 1985 when monitoring wells were installed as part of a groundwater monitoring plan required by the state. In 1987, FDER entered into a Consent Order with OCI whereby the company was required to take corrective action to address the groundwater contamination.

In 1987, Barry Paul sold OCI, including the facility property, to FPR, a Florida corporation formed and owned by George Gordon. Mr. Gordon had been an employee and an officer of OCI. Mr. Gordon expanded the operations by constructing a new containment area on the southern portion of the facility and adding four storage tanks. According to a report submitted by FPR to FDEP, Mr. Gordon collected waste oil from more than 2,000 locations and sold more than 2 million gallons per year. For a brief period during 1991 and 1992, the facility was operated by Larry Van Doorne and his company, South Florida Fuels, Inc., who leased the property from FPR. Mr. Gordon continued to operate the waste oil recycling business on the property until 1992.

Under an agreement with FDER, Mr. Gordon, through his new company, FPR, agreed to conduct the soil and groundwater cleanup required under the 1987 Consent Order between FDER and OCI. Sampling and contamination assessment activities were conducted over a period of several years. In addition, some contaminated soil was removed. Under Florida's underground storage tank reimbursement program, FDEP determined that FPR was eligible for partial reimbursement for some of the cleanup costs incurred by the company. Approximately $114,000 was paid to FPR under this program. Meanwhile, changes under state law eliminated this program. In 1995, FPR, which had ceased business operations at the facility in 1992, advised the state that it could not afford to continue cleanup efforts.

In the spring of 1996, EPA's Emergency Response and Removal program conducted an assessment of the FPR facility. The abandoned facility contained 10 aboveground tanks and 24 drums in poor condition, which appeared to contain waste oil and wastewater. While the tanks and drums were within secondary containment areas, these structures had deteriorated. The contents of the tanks and drums were sampled and the results indicated the presence of volatile organic compounds (VOCs) and other hazardous substances. EPA determined that an immediate response action was warranted to address the imminent threat posed by the tanks and drums and to stabilize the facility pending further evaluation. As a result of this action, all of the tanks and an estimated 13,000 gallons of waste oil and 26,000 gallons of wastewater were removed from the Site. This work was completed in 1997 pursuant to an area of concern with a lower generator for the site, U.S. Sugar Corporation.

A second removal action was conducted in 1999 to address the highly contaminated soils ranging from the surface to a depth of approximately 12 feet bgs. Contaminants removed included chlorinated VOCs and petroleum-related compounds. Approximately 6,000 tons of soil were removed for off-Site disposal. The excavations were filled in with clean soil.

Two additional removal actions are planned for the fall of 2000. Results from the additional characterization of the deep soil contamination documented a zone of residual dense nonaqueous-phase liquid (DNAPL) in the northwestern portion of the facility at a depth from 34 to 43 feet bgs. At one location, contaminants were detected at lower levels, but which were still indicative of residual DNAPL, down to a depth of 59 feet bgs. This contamination is believed to represent a continual source of contamination to the Biscayne aquifer, a sole source of drinking water for Dade and Broward counties. A consent agreement and work plan has been developed with the FPR potentially responsible parties (PRPs) to treat the residual DNAPL contamination in place using a technique known as chemical oxidation. The treatment process involves the injection of chemicals into the zone of contamination, which produces a chemical reaction to transform the contaminants into nontoxic compounds. This method of treatment has been shown to be effective at other sites similar in nature.

Finally, in a effort to address the highly contaminated groundwater at the FPR facility, a groundwater recovery, treatment, and disposal system is planned to be installed as part of a final removal action. This would be a limited action that extracts, treats, and reinjects roughly 100 gallons per minute of groundwater and would be intended to address concentrated groundwater at the facility that is an ongoing source of contamination to the Biscayne aquifer. Groundwater modeling estimates indicate that implementation of this removal action may reduce the long-term cleanup time of the large aqueous plume by about 50 percent.

1.3 Summary of Investigations

Numerous investigations have been conducted by the EPA, the FDEP, the City of Fort Lauderdale, and the former owners of the FPR facility in an effort to (1) determine the source of contamination of the Peele-Dixie Wellfield, and (2) assess the nature and extent of contamination associated with the wellfield, the FPR facility, and other sources of contamination in the area. A brief highlight of the scope of these studies and results is provided in the following subsections. The results from these studies are provided in greater detail in the FPR RI report (1998). Actual reports are available for review in the EPA Administrative Record (AR) for this Site.

To better understand the progression of the studies and sequence of events, it is important to understand that EPA, FDEP, and the City of Fort Lauderdale first began studying the Peele-Dixie Wellfield independent of, and without knowledge of, the severity of the problems associated with the FPR facility. In 1995, the magnitude of the problems associated with FPR was first discovered. Independent of these investigations of the Peele-Dixie Wellfield, the former owners of the FPR facility were conducting some limited investigations of the FPR facility pursuant to an order with the FDER (now known as FDEP), under Florida's petroleum cleanup program.

1.3.1 FPR Contamination Assessment

Assessment of the FPR facility by the owner, Barry Paul, began in 1984 under the direction of the FDER and the Broward County Environmental Quality Control Board (now known as the Broward County Department of Natural Resources Protection. The limited assessment included the installation of monitoring wells and the collection of soil and groundwater samples. This assessment culminated in the issuance of a contamination assessment report (CAR) in 1991, and a CAR addendum in 1991. The reports concluded that approximately 4,500 cubic yards (yds^3) of contaminated soil was present above the water table, along with the presence of free-phase waste oil floating on the water table (i.e., light nonaqueous-phase liquid [LNAPL]). Dissolved- phase groundwater contaminated by VOCs and petroleum compounds was also detected near the facility boundary to the east and south, with some limited migration beyond the facility boundary to the west and north. As part of these studies, approximately 50 tons of contaminated soil were excavated (but 31 tons were reportedly backfilled into the excavation) and 225 gallons of waste oil were recovered from the excavation.

1.3.2 FDER Groundwater Investigation

In December 1986, the City of Fort Lauderdale detected the presence of 1,2-dichloroethene (DCE) in production well number PW-18 located in the southern portion of the Peele-Dixie Wellfield. This well was 1 of 26 supply wells that comprise the Peele-Dixie Wellfield. The city instituted interim measures to control the spread of contamination in the wellfield by discontinuing the pumping of most of the wells in the southern part of the wellfield. Between March 1987 and January 1992, the city undertook remedial measures whereby contaminated groundwater was pumped from PW-18 into a shallow percolation pond for aeration.

Concurrent with these activities, the FDER initiated a study in 1987 in an attempt to locate the source of the contamination. A total of 49 deep (85 to 95 feet bgs) and 11 shallow wells (40 to 50 feet bgs) were sampled as part of the study. From the 1988 report on this work, FDER concluded that the Broward County 21st Manor Dump was the most likely source of the contamination, but that the assessment was complicated by the groundwater gradient reversal caused by the pumping of the Peele-Dixie Wellfield and from the interim remedial actions conducted by the City.

1.3.3 EPA Investigation - 21st Manor Dump

Based on the conclusions from the FDER study, the proximity of the dump to the Peele-Dixie Wellfield, and prior uncontrolled use of the dump, EPA contracted with NUS Corporation (NUS) to conduct several investigations. Reports were subsequently issued in 1987, 1988, and 1990. The studies included the installation of numerous boreholes and monitoring wells and the collection of numerous soil and groundwater samples. Although these studies further documented the extent of groundwater contamination, no VOCs were detected in samples collected from the dump that would indicate that the dump was the source of the wellfield contamination.

1.3.4 EPA Remedial Investigation

As a continued effort to locate the source of the wellfield contamination and to ensure that there were no ongoing sources of contamination to the Biscayne aquifer, EPA contracted with Bechtel Environmental, Inc. to conduct an RI of the Peele-Dixie Wellfield. Two separate field investigations were conducted in September 1994 and in August 1995 to better define the extent of groundwater contamination south of the wellfield. The first phase of the investigation included the installation of 12 monitoring wells in an area southward from the wellfield to I-595, along with the sampling of existing wells in the Peele-Dixie Wellfield. The second phase of study included the installation of 13 additional monitoring wells extending further south of the FPR facility, along with the resampling of existing wells located throughout the plume. Plume maps generated as a result of the 1994 and 1995 studies are shown in Figures 1-3 and 1-4, respectively.

As a result of these studies, EPA concluded that the FPR facility represented a significant source of contamination to the Biscayne aquifer and was the apparent source of contamination of the Peele-Dixie Wellfield. Based on this assessment, EPA initiated additional assessments of the FPR facility to better define the nature and extent of contamination at the facility. Investigation of the FPR facility included the collection of hundreds of soil samples to better define the nature and extent of contamination at the facility. Additional groundwater monitoring wells were also installed to assess the extent of groundwater contamination. The results from this extensive study are documented in the RI report for the FPR Superfund Site prepared by Bechtel Environmental, Inc. (Bechtel) in 1998. The RI report is included in the AR for this Site. A brief summary of the Site characteristics documented in the RI report is presented in Section 4.0 of this ROD.

1.3.5 PRP Group DNAPL and Groundwater Investigation

Additional characterization of the residual DNAPL was conducted by the PRP Group as part of the 1999 soil removal. Additional soil borings were installed, along with the collection of several hundred soil samples. These results confirmed the presence of a residual DNAPL zone in a localized area in the northwest portion of the facility. The residual DNAPL was detected at a depth that ranged from 34 to 43 feet bgs. At one location, based on EPA's analysis, contaminants were detected at concentrations that were lower, but were still indicative of residual DNAPL down to a depth of 59 feet bgs. The results from this investigation are documented in a reported prepared by Golder Associates, entitled *DNAPL Investigation Report, Florida Petroleum Reprocessors, Davie, Florida*, in January 2000.

Due to the length of time from the last sampling of the groundwater plume, and as an aid in the evaluation of potential groundwater cleanup alternatives for the FPR facility, Golder Associates resampled the groundwater monitoring wells at the facility and throughout the plume in January 2000. The results are summarized in the document, *Groundwater Sampling Report, Florida Petroleum Reprocessors Superfund Site, Davie, Florida*, prepared by Golder Associates in February 2000. The results show a general decrease in contaminant levels near to and north of

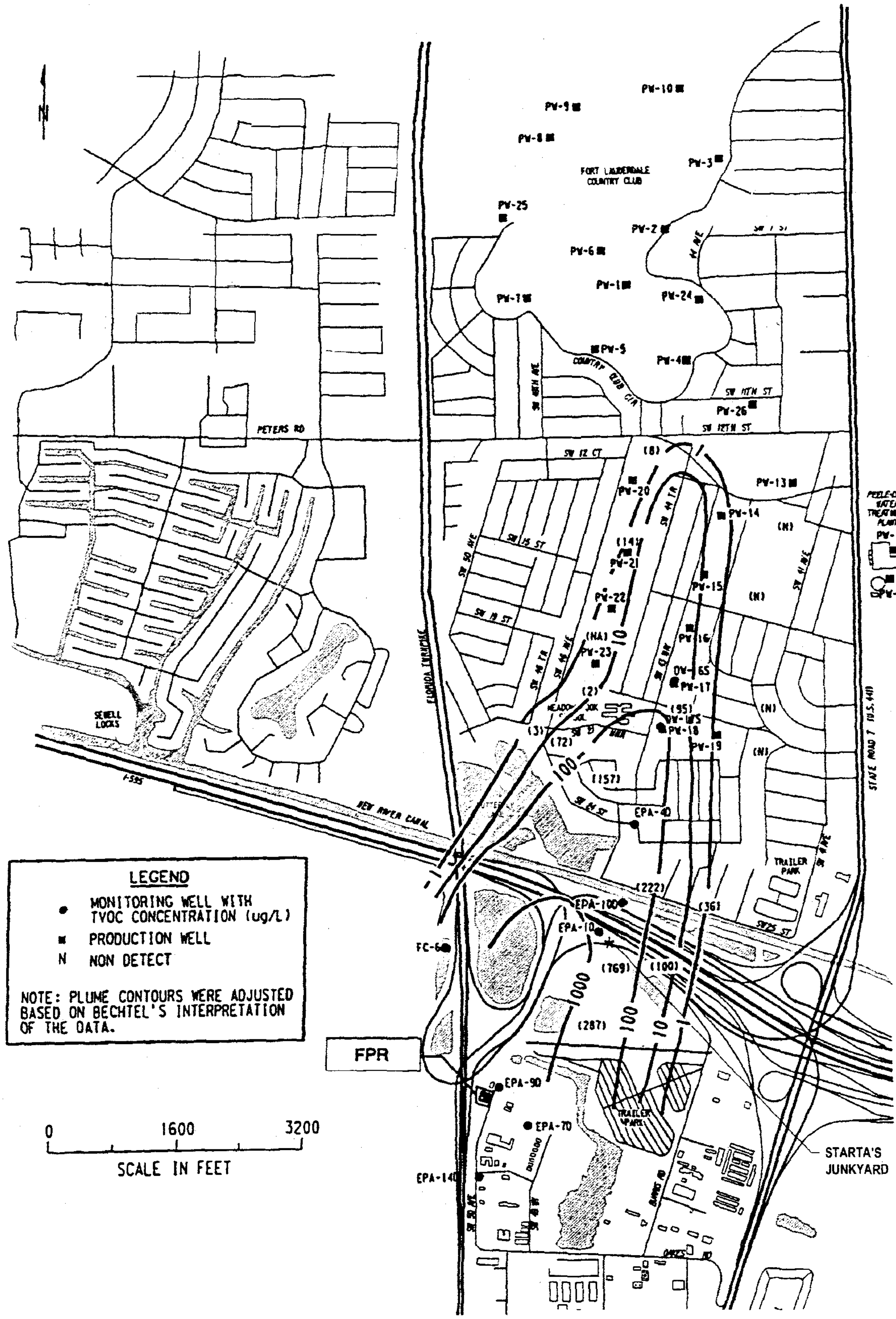


Figure 1-3
TVOC Plume in Deep Aquifer - 1994
Florida Petroleum Reprocessors, Davie, Florida

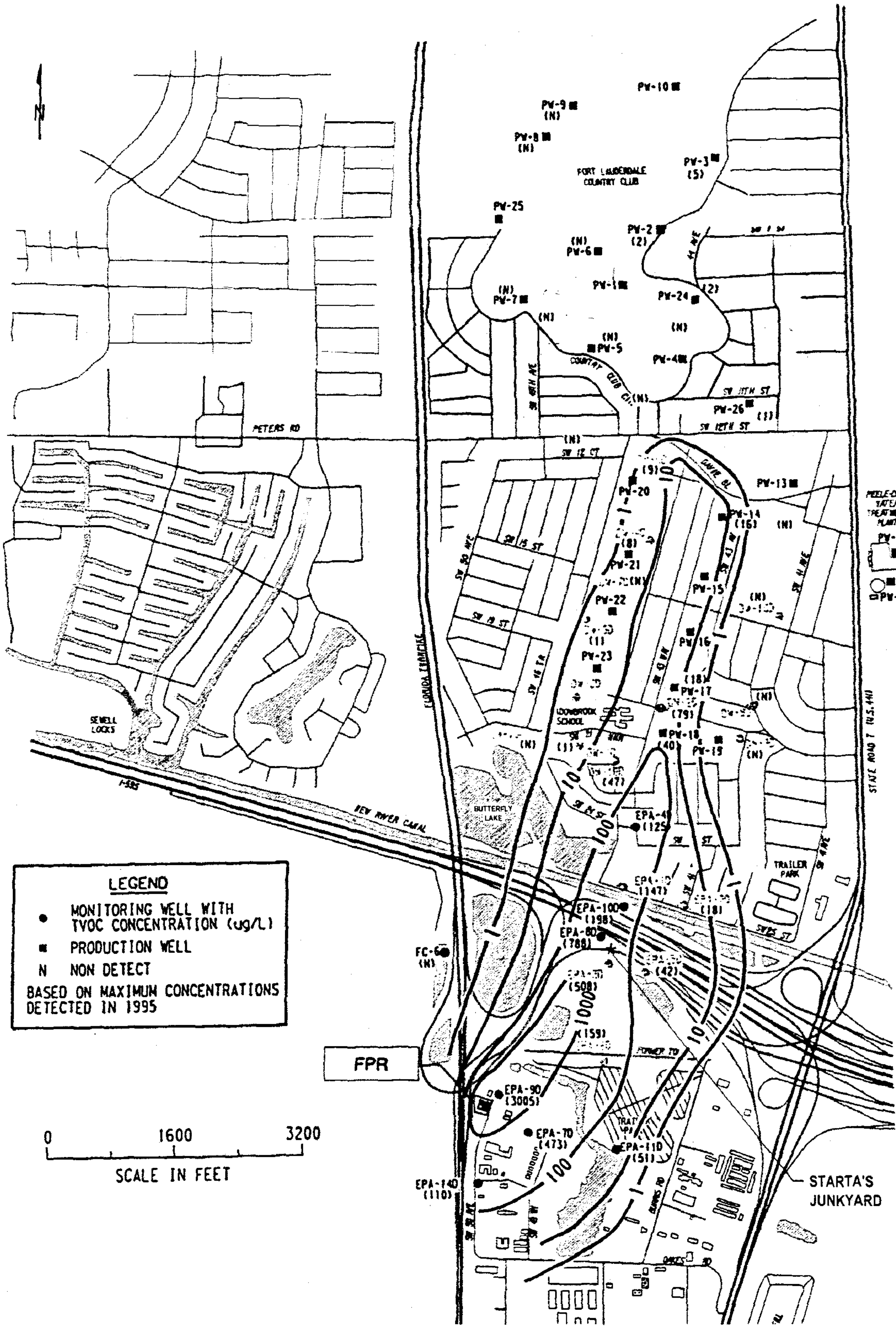


Figure 1-4
TVOC Plume in Deep Aquifer - 1995
Florida Petroleum Reprocessors, Davie, Florida

the FPR facility. Contaminant levels south of the Site have increased, indicating a continued southward migration of the plume.

2.0 COMMUNITY PARTICIPATION

The RI and FS reports, groundwater modeling report, and a Proposed Plan for the FPR Site were first released to the public in June 1998. These documents were made available to the public in the AR maintained at the EPA Docket Room in Region 4, Atlanta, Georgia, and at the Broward County, Riverland Branch Library in Fort Lauderdale, Florida. A notice of availability of these documents was published in the Fort Lauderdale *Sun-Sentinel* on June 7, 1998. A public comment period was held from June 9 through August 9, 1998, and a public meeting was held on June 18, 1998. At this meeting, EPA, along with representatives from FDEP, and the Florida Department of Health presented its proposed plan for cleanup and answered questions about the Site and remedial alternatives under consideration.

The Proposed Plan was met with significant opposition from the community and PRPs for the Site. In general, the community felt that time frames estimated for the remediation of the Site were too long and did not address potential threats to the Peele-Dixie Wellfield, a nearby public drinking water supply. The PRPs for the Site contended that the potential threats posed by the Site had not been properly characterized and that the corresponding response actions proposed by EPA were excessive and not warranted. Comments received on the 1998 Proposed Plan are contained in the AR for this Site.

In response to these comments, EPA decided not to adopt the preferred remedial alternative in the Proposed Plan and did not issue a ROD for the Site. EPA then began a process of additional Site characterization and evaluation of additional remedial alternatives. In conjunction with the additional Site characterization work, EPA and the PRPs began an evaluation of removal actions that could be taken to mitigate threats to human health and the environment through the removal of concentrated sources of contamination to the Biscayne aquifer.

After this additional assessment was completed, a second Proposed Plan was issued in June 2000. A notice of availability of these documents was published in the *Sun-Sentinel* on June 18, 2000. A public comment period was held from June 20 through August 21, 2000, and a public meeting was held on June 27, 2000. At this meeting, representatives from EPA and U.S. Army Corps of Engineers presented a summary of the Proposed Plan and answered questions about the Site and remedial alternatives under consideration.

A response to the comments received during this period is included in the Responsiveness Summary, which is included in Appendix A of this ROD. This decision document presents the selected remedial action for the FPR Superfund Site in Davie, Florida, chosen in accordance with CERCLA, as amended by SARA and, to the extent practicable, the National Contingency Plan (NCP). The decision for this Site is based on the AR.

3.0 SCOPE AND ROLE OF RESPONSE ACTION

This action is expected to be the final action for the FPR Superfund Site. Since threats posed by soil contamination and residual DNAPL will be addressed this fall through a removal action, the remedial action objectives (RAOs) for this remedy would be to prevent the potential threats posed by the contaminated Site groundwater. Ingestion of groundwater from this portion of the aquifer poses a potential risk to human health because EPA's acceptable risk range is exceeded and concentrations of contaminants are greater than the maximum contaminant levels (MCLs) for drinking water (as specified by the Safe Drinking Water Act). The goal of this remedy would be to reduce the toxicity, mobility, and volume of those contaminants that pose the principal threat at the Site. The principal threat is comprised of areas of highly contaminated groundwater that act as continual sources of contaminants to the Biscayne aquifer and the drinking water resources within the influence of the Peele-Dixie Wellfield.

4.0 SUMMARY OF SITE CHARACTERISTICS

4.1 Physical Characteristics of Study Area

The FPR Site is located along the eastern edge of the Atlantic Coastal Ridge, which gently slopes eastward toward the Atlantic Ocean. Surface elevations range from 3 to 10 feet above mean sea level.

4.1.1 Climate

The climate for the Broward County, Florida area can be characterized by long, humid summers and mild winters. The Atlantic Ocean has a moderating effect on temperatures along the coast, but effects diminish a few miles inland. Moderation of the coastal winter yields a tropical climate, while the rest of the inland areas are characterized as humid subtropical.

Average annual rainfall for the area is approximately 64 inches, with the majority of the precipitation occurring between June through October. Mean annual lake evaporation is estimated at 50 inches, resulting in a net annual precipitation of about 14 inches. The prevailing wind direction is southeasterly during the period March through September and northwesterly during the other months.

4.1.2 Surface Water Hydrology

Drainage patterns at the FPR facility are controlled largely by man-made drainage structures, such as culverts and swales. Rainfall that does not percolate into the soil at the facility may run off into SW 50th Street or to the wetlands to the south. Drainage from the wetlands is to the South Fork of the North New River Canal via a series of channels and culverts, which are part of the Florida Turnpike drainage system.

Other drainage features in the area include numerous nearby borrow pit lakes and the north and south forks of the New River Canal. The North New River Canal is part of an extensive drainage system extending from Lake Okeechobee to the Atlantic Ocean. Sewell Lock, the most downstream salinity control structure prior to transitioning to freshwater, is located approximately 1 mile northwest of the Site. The portion of the canal closest to the Site is tidally influenced. The South New River Canal is located approximately 1.5 miles south of the Site. There are no apparent direct drainage pathways from the Site to either canal feature.

4.1.3 Soils and Geology

Surface soils at the FPR facility generally consist of fine- to medium-grained sand and fine limestone gravel containing varying amounts of artificial materials, including glass, wood, oily rags, and other debris. This disturbed material ranges in thickness from 6 to 66 inches, with the greatest thickness located in the northwest corner of the facility. Undisturbed material includes a natural fine- to medium-grained sand that extends downward to the uppermost semiconsolidated bedrock unit.

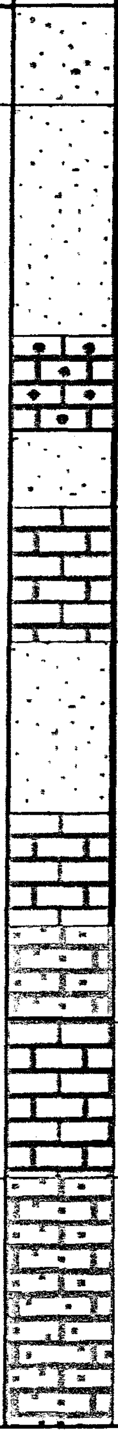
Depositional environments in the Fort Lauderdale area range from beach shelf and barrier sand bars to reefs. Sedimentary deposits resulting from the transitional nature of the deposits cause some difficulty in assigning formational names. Table 4-1 presents a generalized stratigraphic column for the FPR Site using site-specific descriptions from geologic borings and formational descriptions from the literature. Results from geologic borings conducted during the RI were used to compile geologic diagrams of the formations along both a north-south and east-west axis. The diagrams are shown in Figures 4-1 through 4-3 and the locations of the borings are shown in Figure 4-4. One of the most noteworthy observations from the geologic investigation is the variability of the elevation of the top of the Miami Oolite. As the uppermost semiconsolidated unit at the FPR Site, the variability in the elevation of this contact might influence the downward migration of contaminants.

4.1.4 Hydrogeology

An unconfined groundwater system commonly referred to as the surficial aquifer system underlies the Site. The surficial aquifer system is comprised by the Pamlico Sand, Miami Oolite, Key Largo, Anastasia, Fort Thompson, and portions of the Tamiami Formations. The base of the surficial aquifer system is defined as that point where hydraulic conductivities of less that 10 feet per day (ft/day) are encountered. In the vicinity of the Site, the base of the surficial aquifer is encountered at a depth of approximately 285 feet bgs. Within the surficial aquifer system is a highly productive aquifer known as the Biscayne aquifer. The Biscayne aquifer is defined as that portion of the aquifer with hydraulic conductivities exceeding 1,000 ft/day, although it is not uncommon for hydraulic conductivities to exceed 10,000 ft/day.

The Biscayne aquifer generally occurs within Dade, Broward, and portions of Palm Beach counties and, as a result, is the sole source of drinking water for much of the population in Southeast Florida. The Biscayne aquifer has been designated by EPA as a sole source drinking water aquifer and by FDEP as a drinking water resource warranting a high degree of protection.

Table 4-1
Generalized Site Stratigraphy
Florida Petroleum Reprocessors, Davie, Florida

Age	Lithology	Formation	Observed Thickness (ft)	Description
Recent		None	0.5 to 5.5	fine- to medium-grained quartz sand with fine limestone gravel and debris
Pleistocene (formations may be contemporaneous)		Pamlico sand	3 to 65	fine- to medium grained quartz sand, with thin carbonate cemented zones
		Miami oolite	0 to 40	oolitic limestone with fine- grained quartz sand forming nuclei of ooids, underlain by quartz sand layer
		Key Largo limestone	0 to 22	crystalline reefal limestone
		Anastasia formation	40 to 80	sand, shelly sand, shelly and nodular sandstone, and sandy limestone
		Fort Thompson formation	0 to 15	fossiliferous sandy limestone
Tertiary (Miocene)		Tamiami formation	>115	interbedded limestone, sandstone, and sand grading to finer-grained materials at depth

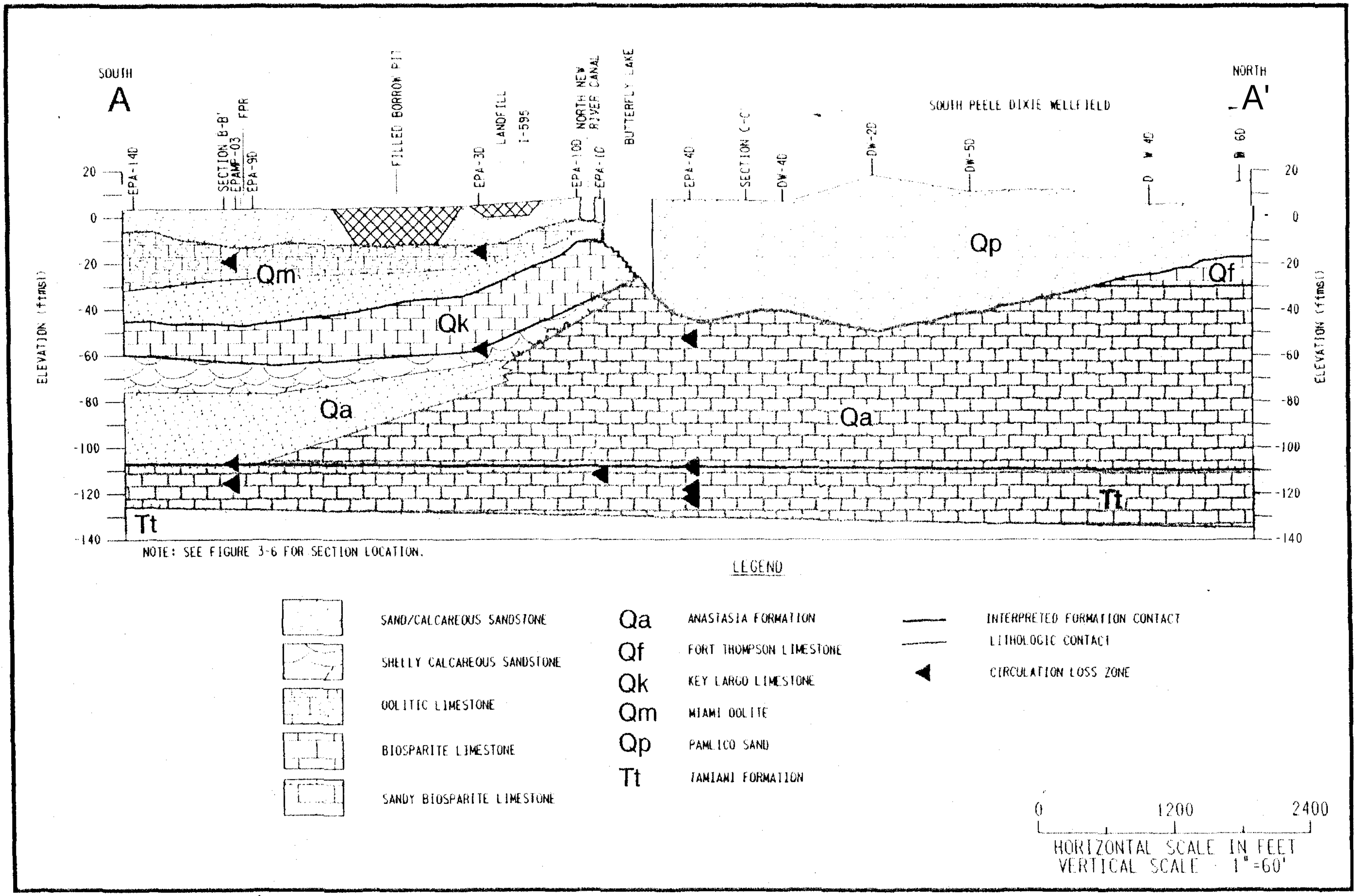


Figure 4-1
Generalized Geologic Cross-Section A-A'
Florida Petroleum Reprocessors, Davie, Florida

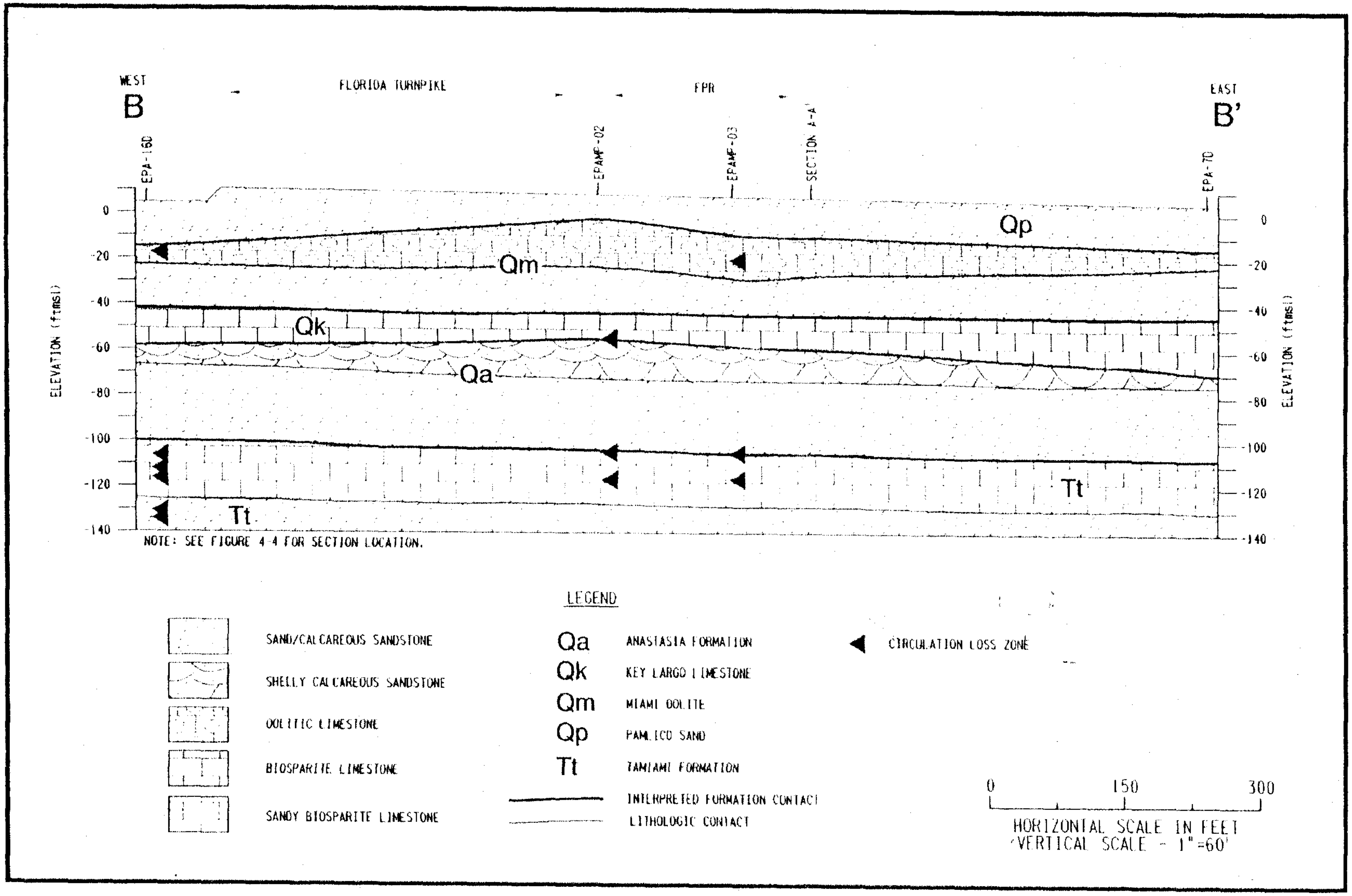


Figure 4-2
Generalized Geologic Cross-Section B-B'
Florida Petroleum Reprocessors, Davie, Florida

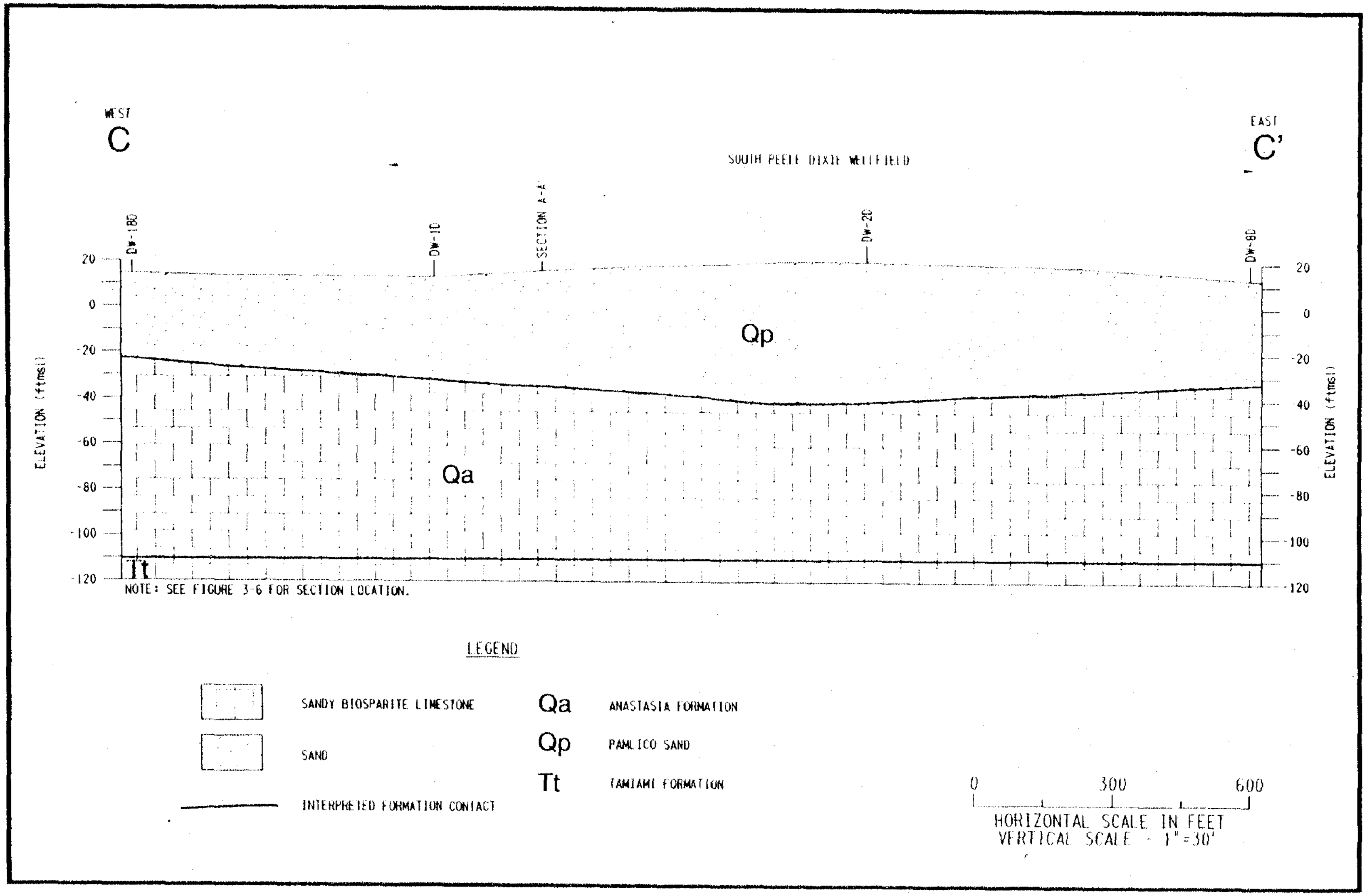


Figure 4-3
Generalized Geologic Cross-Section C-C'
Florida Petroleum Reprocessors, Davie, Florida

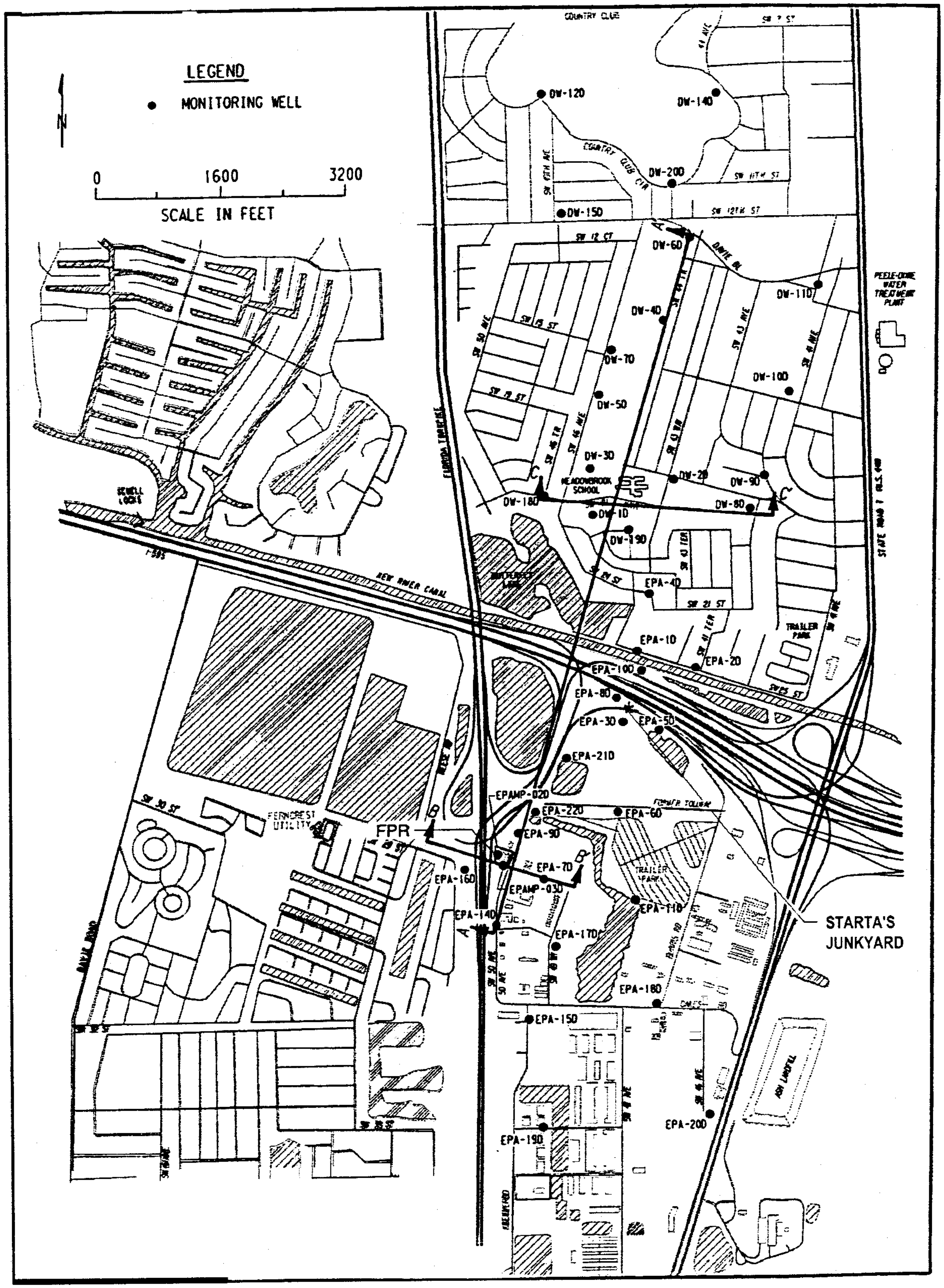


Figure 4-4
Borehole and Cross-Section Locations
Florida Petroleum Reprocessors, Davie, Florida

As shown in Figure 1-2, wellfields for numerous municipal and private drinking water supplies that obtain water from the Biscayne aquifer are located in the vicinity of the Site. The City of Fort Lauderdale's Peele-Dixie Wellfield is the largest groundwater pumping center in proximity to the Site. In the late 1970s, production from the Peele-Dixie Wellfield averaged about 14 million gallons per day (mgd), and dropped to about 12 mgd in the 1980s. As a result of contamination in the southern part of the wellfield, pumping in the southern part of the wellfield ceased, and production from the entire wellfield dropped to about 6 to 9 mgd. While other wellfields are within the vicinity of the Site, none of the wellfields appear to be in immediate threat of contamination by the Site.

The FPR Site is located in an area of major groundwater use for municipal and industrial supply. Groundwater flow is generally to the southeast, but local disturbances in the groundwater flow result from groundwater pumping and drainage canals. These disturbances may result in a northeastward groundwater flow direction. Hydraulic gradients within the aquifer were estimated to range from 0.00012 in the dry season to 0.00016 in the wet season. The average wet season potentiometric surface as measured from 1974 to 1982 and the average dry season as measured in 1988 are presented in Figures 4-5 and 4-6, respectively.

Vertical groundwater gradients were also measured as part of the RI. The results indicate a high degree of variability in distribution of the upward and downward gradients. This variability is interpreted to be indicative of heterogeneity in the aquifer. Although vertical gradients measured during the RI were low, they were of the same magnitude as the horizontal gradients. Changes in the vertical gradients likely affect the migration of contaminants in the aquifer, and are believed to be indicative of a three-dimensionally complex distribution of the dissolved-phase contamination in the surficial aquifer system.

To aid in the evaluation of groundwater remedial alternatives and evaluate historical flow paths, EPA retained the U.S. Army Corps of Engineers Waterway Experimental Station to develop a numerical groundwater flow model of the FPR Site area, including the Peele-Dixie Wellfield. The model was calibrated to within 10 percent of the normalized root mean squared error using water table observations. Sensitivity analyses were performed to determine the model's accuracy. A 19-year (January 1978 through December 1996) transient simulation was produced, which included the time period during which the FPR facility was in operation. Hydrologic data input into the 19-year simulation included precipitation, temperature, solar radiation, canal stages, and pumping data from utilities. Groundwater modeling results used in the development and evaluation of alternatives in the FS addendum (FSA) are available for review in the AR.

4.1.5 Demography and Land Use

The FPR Site is located in an urban, heavily populated, portion of Broward County, Florida. Approximately 165,234 people live within a 4-mile radius of the FPR facility. Due to the nature of the location of the Site in an industrial park, several other facilities were identified that currently manage or have previously managed waste material. As a result, the following facilities were included in the sampling conducted outside the FPR property: Atlas Waste Magic,

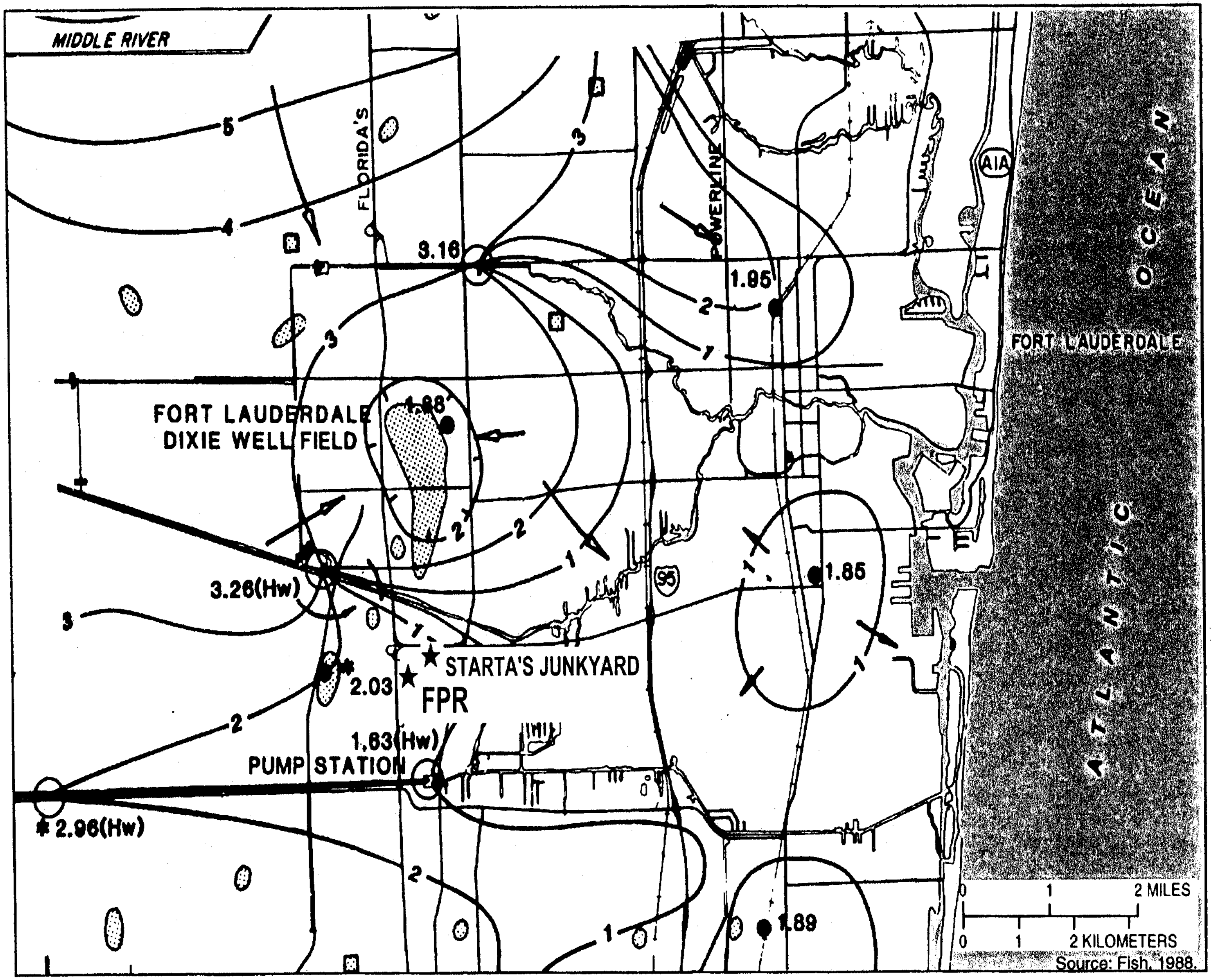


Figure 4-5
Average Wet Season Potentiometric Surface Map (1974-1982)
Florida Petroleum Reprocessors, Davie, Florida

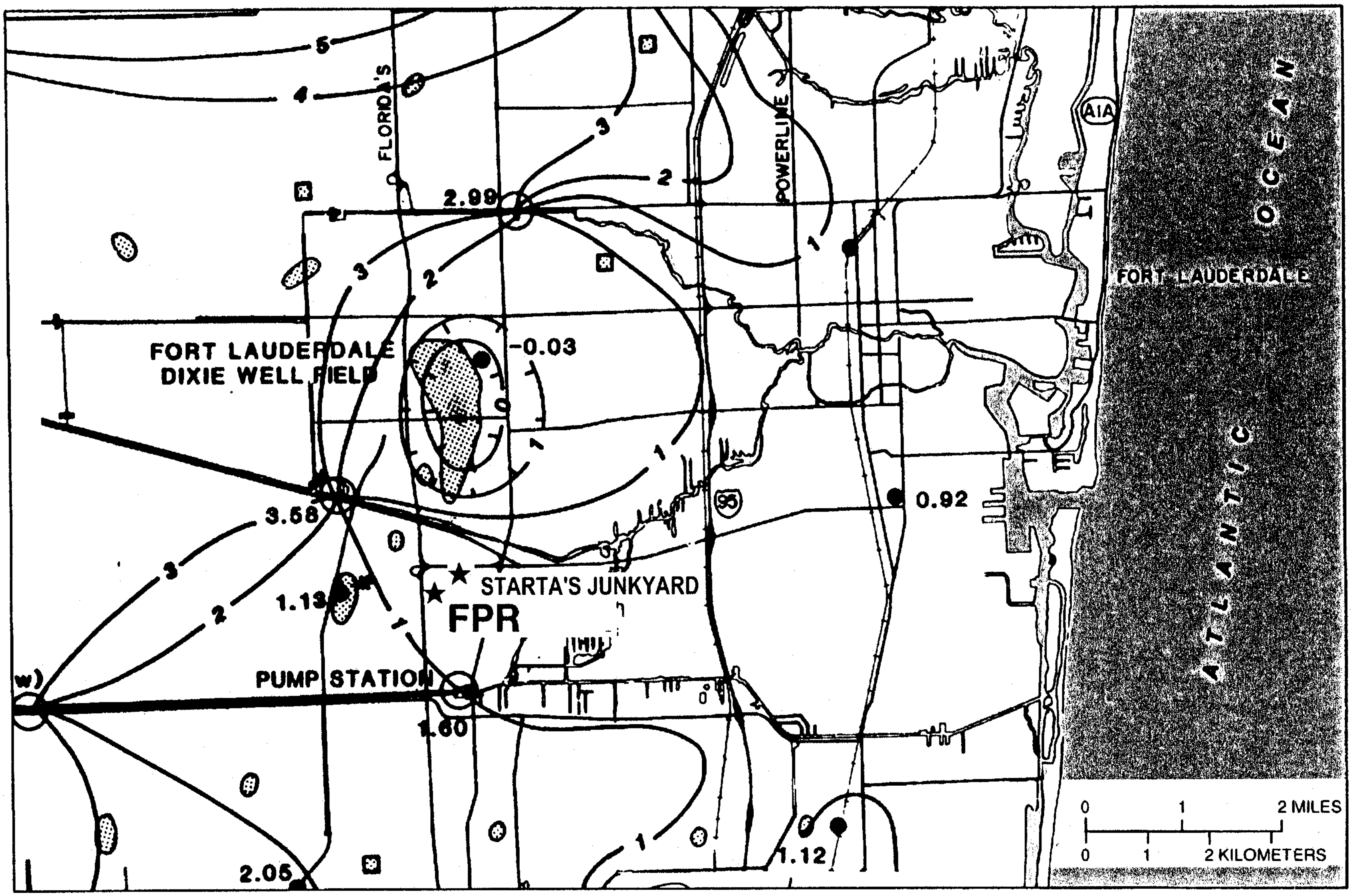


Figure 4-6
Dry Season Potentiometric Surface Map, April 26-29, 1998
Florida Petroleum Reprocessors, Davie, Florida

Source: Base map is Fort Lauderdale South, Florida, USGS 7.5 minute quadrangle, photorevised 1983. Poteniometric contours from Lietz, 1991. Countour interval is variable.

Wheelabrator South Broward, Inc., Perma-Fix Environmental Services (Perma-Fix), Petroleum Management, Inc. (PMI), and Davie Concrete. The locations of these facilities are shown on Figure 4-7. Results from sampling these nearby facilities did not indicate the presence of significant concentrations of VOCs (i.e., the same magnitude of concentrations of VOCs reported at the FPR facility). A more detailed summary of the results is presented in Section 4.2.3 of this ROD.

The industrial park where the Site is located does not appear to be under substantial development pressure at this time. Recent development in the area has primarily been in the form of light industrial, commercial, and warehouse facilities. EPA is unaware of any future plans by Broward County or the Town of Davie for large-scale future developments in the area.

4.2 Nature and Extent of Contamination

This section of the ROD provides a brief overview of the summary of the nature and extent of contamination identified during the RI of the FPR facility and surrounding area, as well as data collected during the initial investigation of the Peele-Dixie Wellfield. A principal goal of the RI was to delineate and characterize the source areas at the FPR facility responsible for creating the large area of groundwater contamination. Included in the assessment of the source was a thorough investigation of the potential presence of a DNAPL. Secondly, the RI was intended to investigate the possibility of other sources of contamination that may be contributing to the large area of groundwater contamination.

It is important to note, however, that since the completion of the RI, significant removal of contaminated soils documented during the RI has either been completed or is underway. All of the data are presented primarily for background purposes to illustrate the severity of the environmental problems posed by this facility and to explain why it caused such significant impacts on the Biscayne aquifer and the Peele-Dixie Wellfield.

With regard to the groundwater, much of the data from the RI are included to establish the historical conditions at the Site. Most recently, the groundwater plume was resampled in January 2000. These results are documented in a report entitled *Groundwater Sampling, Florida Petroleum Reprocessors Superfund Site*, Golder Associates, February 2000. With regard to the highly contaminated deep source groundwater remaining at the facility, a removal action is planned to begin in fall of 2000.

4.2.1 Scope of Investigation

The scope of the RI included a comprehensive assessment of surface and subsurface soils, groundwater, and surface water. The assessment not only included the collection of samples for analysis, but numerous other quantitative measurements of water levels and water quality data to evaluate contaminant movement. As an indication of the scope of the field work, groundwater samples were collected from over 100 monitoring wells, spanning an area over 800 acres in size.

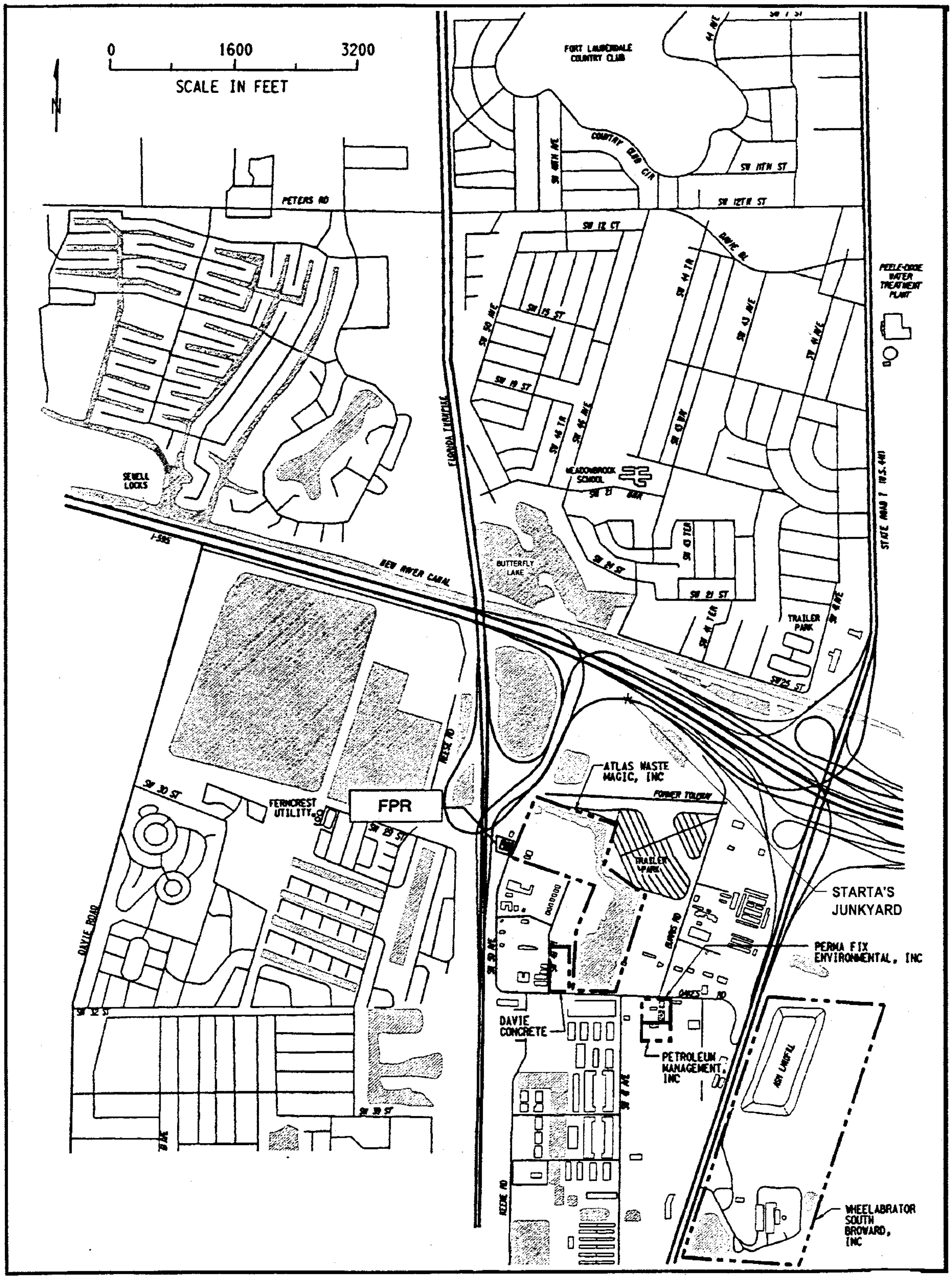


Figure 4-7
Other Potential Sources of Contamination Investigated
Florida Petroleum Reprocessors, Davie, Florida

Over 300 soil samples were collected in the characterization of the FPR facility. A summary of the samples collected and analyzed as part of the RI is provided in Table 4-2. Figures 4-8, 4-9, 4-10 provide the locations of the wells sampled as part of the RI. Table 4-3 provides a summary of the construction details of the monitoring wells. Figure 4-11 provides the soil boring/sample locations. Soil collection depths from the numerous sampling locations is presented, along with the summary of the analytical results. For a thorough summary of the results from the RI, the final RI report (1998) by Bechtel should be consulted.

4.2.2 Source Area Investigation

Historical operations at the FPR facility apparently resulted in large-scale releases of solvent-contaminated wastes either at the surface or in the shallow subsurface (i.e., leaking underground storage tank). One of the objectives of the RI was to investigate the potential presence of nonaqueous-phase liquids that may have resulted from former operations at the facility. Additional source characterization included the investigation of soils contaminated by petroleum-related waste.

DNAPL Investigation

Several studies were conducted in an effort to document the potential presence of DNAPL, and if present, characterize the extent of contamination. Studies were conducted by EPA during the RI, and pursuant to a contract with EPA and the Department of Energy, Idaho National Engineering Laboratory. Additional characterization work was conducted on behalf of the PRPs by Geraghty and Miller and Golder Associates. Detailed results from these studies are included in the AR for this Site.

Investigation of the potential presence of a DNAPL included field screening of soil samples, laboratory analysis of soil samples, and an evaluation of contaminant concentrations in groundwater. Soil samples from numerous soil borings were collected and screened using EPA's DNAPL site evaluation protocol (1993). Based on the screening results, deep soil borings EPASB-01 and EPA-BS-12 yielded numerous soil samples with positive evidence of the presence of residual DNAPL. A summary of the screening results is provided in Table 4-4. The evidence for DNAPL was found at intermittent depths in both borings down to depths of approximately 60 feet bgs and was observed or detected in both unconsolidated sands and bedrock. None of the soil borings encountered contained an accumulation of DNAPL.

A comparison was also conducted between contaminant concentrations in groundwater and the 1 percent of solubility criterion widely recognized as a potential indicator of DNAPL. This evaluation is summarized in Table 4-5 and shows that trichloroethylene (TCE), 1,1,1-trichloroethane (TCA), 1,2-DCE, 1,1-DCE, and vinyl chloride were all detected in at least two locations with concentrations far exceeding 1 percent of the solubility criterion. Many of the compounds were detected in concentrations exceeding 10 percent of the respective solubilities. Cherry, et. al. (1995) states that "the finding of several percent of solubility is a reasonable signal that DNAPL may be present."

Table 4-2
Summary of RI Field Activities
Florida Petroleum Reprocessors, Davie, Florida

Field Activities	Qty	Number of Samples Collected/Analyses Requested									
		VOC	BNAE	Pest/ PCBs	Total Metals	TPH	TOC	Anion/ Cation	Geo-chemical	Field Screening	
										GC	FASP
On-Site Soil Investigation											
Deep Soil Borings	6	35	17	0	0	0	9	0	0	194	100
Piezometer Soil Borings	34	12	3	3	0	37	2	0	0	115	57
Risk Assessment Borings	14	40	40	34	40	0	0	0	0	0	0
On-Site Groundwater Investigation											
Piezometers	34	23	14	4	4	0	0	13	0	39	31
New Multiport Wells	3	25	13	0	12	0	12	13	13	0	0
Existing Monitoring Wells	6	6	6	2	6	0	0	6	6	0	0
Off-Site Soil Investigation											
New Monitoring Well Borings	3	10	10	10	10	0	0	0	0	0	0
Surface Soils (FASP Area)	2	4	4	4	4	0	0	0	0	0	0
Off-Site Groundwater Investigation											
New Monitoring Wells	8	16	8	0	8	0	0	8	0	0	0
Existing Monitoring Wells	50	50	8	0	0	0	0	49	45	0	0
Vicinity Monitoring Wells	16	16	0	0	0	0	0	0	0	0	0
Off-Site Surface Water and Sediment Investigation											
Surface Water Samples	6	6	6	6	0	0	0	6	0	0	0
Sediment Samples	5	5	5	5	5	5	0	0	0	0	0
Totals		248	134	68	89	42	23	95	64	348	188

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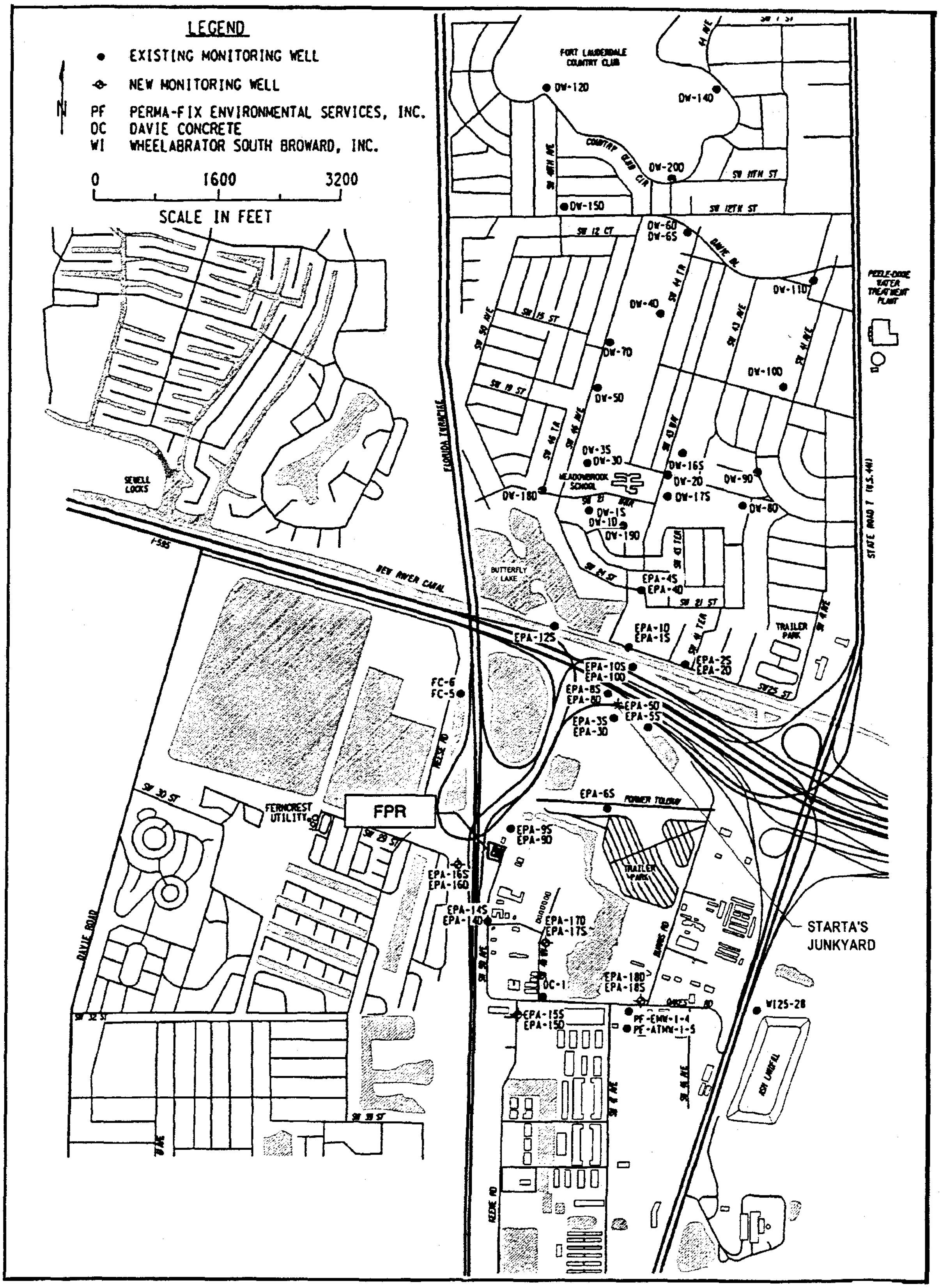

Figure 4-8
Off-Site Monitoring Well Locations
Florida Petroleum Reprocessors, Davie, Florida

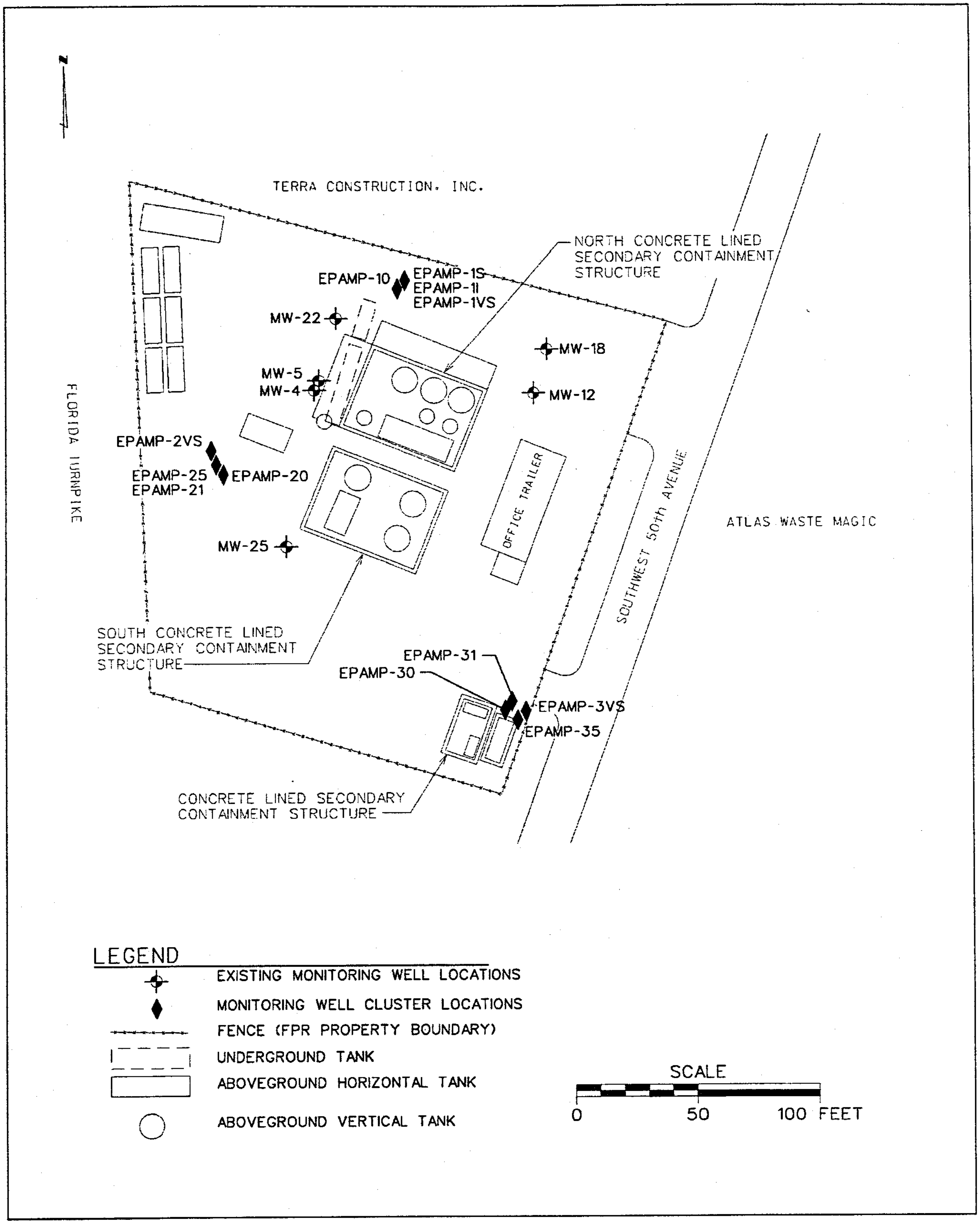

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Figure 4-9
On-Site Monitoring Well Locations
Florida Petroleum Reprocessors, Davie, Florida

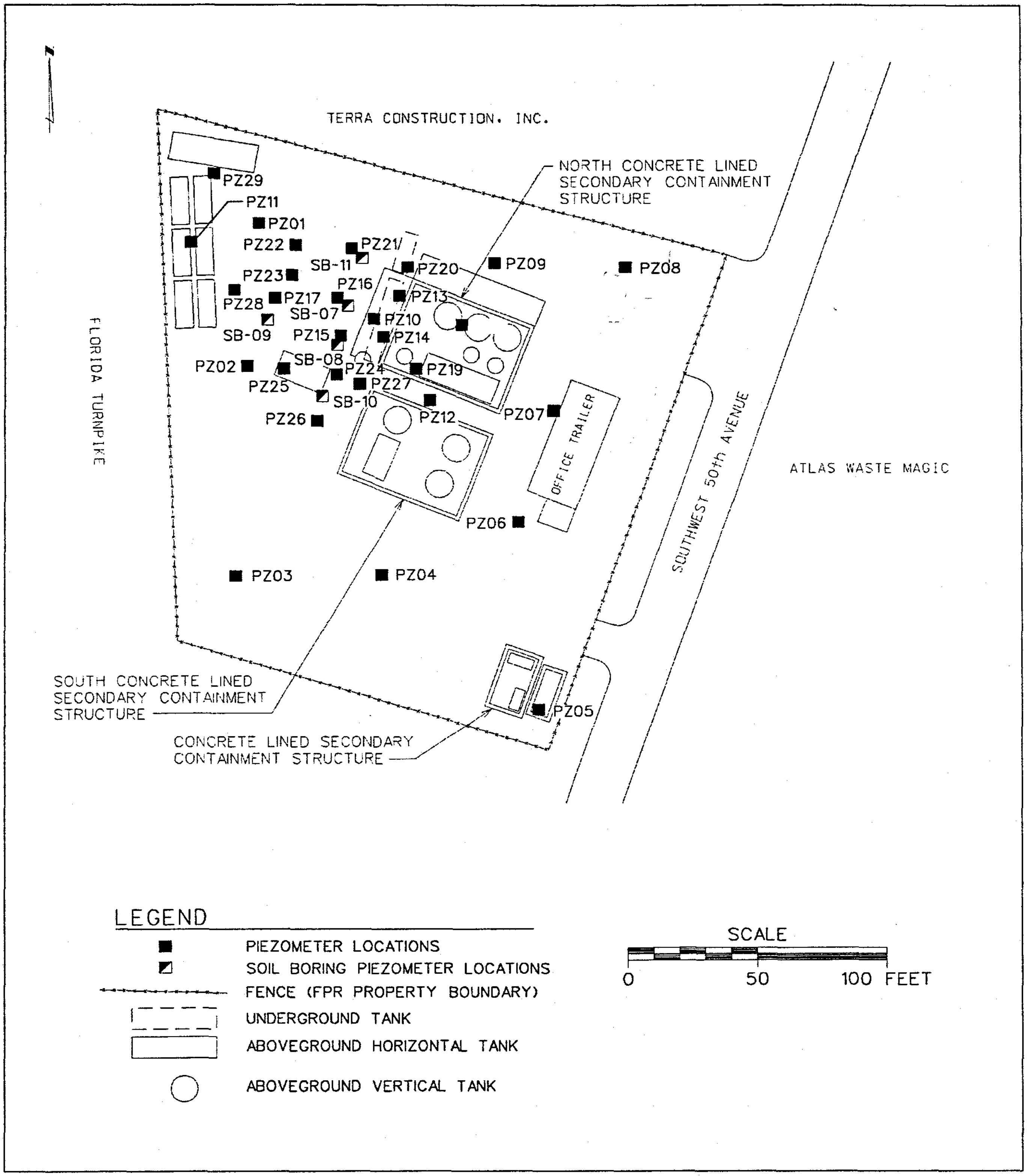


FIG4-10.DGN

Figure 4-10
On-Site Piezometer Locations
Florida Petroleum Reprocessors, Davie, Florida

Table 4-3
Construction Details for Piezometers and Monitoring Wells
Florida Petroleum Reprocessors, Davie, Florida

Well ID	Northing	Easting	Ground Elev. (ft msl)	Top of Casing (ft msl)	Casing Stick-up	Total Depth (ft bls)	Screen Top (ft bls)	Screen Bottom (ft bls)	Screen Type	Well Diameter
Off-Site Monitoring Wells										
EPA-1S	639,342	915,429	5.40	5.18	-0.25	61.50	50.00	60.00	0.02	2
EPA-1D	639,339	915,439	5.40	5.09	-0.29	141.50	130.20	140.50	0.02	2
EPA-2S	639,113	916,194	6.20	6.00	-0.24	61.50	50.80	60.80	0.02	2
EPA-2D	639,115	916,183	6.10	5.96	-0.18	141.50	130.80	140.80	0.02	2
EPA-3S	638,386	915,256	4.80	7.81	2.98	61.50	50.80	60.80	0.02	2
EPA-3D	638,383	915,266	4.90	7.92	2.99	142.50	131.80	141.80	0.02	2
EPA-3VD	638,380	915,280	4.60	7.61	3.02	201.00	190.00	200.00	0.02	2
EPA-4S	640,103	915,580	7.50	7.23	-0.25	61.50	50.80	60.80	0.02	2
EPA-4D	640,102	915,590	7.30	7.22	-0.08	141.50	130.80	140.80	0.02	2
EPA-5S	636,280	915,709	4.30	6.99	2.74	61.50	50.80	60.80	0.02	2
EPA-5D	636,267	915,720	4.50	7.39	2.92	141.50	130.80	140.80	0.02	2
EPA-6S	637,165	915,222	7.40	10.17	2.76	61.50	50.80	60.80	0.02	2
EPA-6D	637,170	915,211	8.50	11.25	2.79	141.50	130.80	140.80	0.02	2
EPA-7D	636,285	914,283	2.70	3.11	0.39	141.00	130.00	140.00	0.02	2
EPA-8VS	638,710	915,184	7.80	7.78	-0.04	21.00	9.50	19.50	0.02	2
EPA-8S	638,715	915,174	7.80	7.66	-0.11	61.00	50.00	60.00	0.02	2
EPA-8D	638,719	915,167	7.60	7.61	-0.01	141.00	129.50	139.50	0.02	2
EPA-9S	636,763	913,912	3.30	3.40	0.10	61.00	50.00	60.00	0.02	2

Table 4-3
Construction Details for Piezometers and Monitoring Wells
Florida Petroleum Reprocessors, Davie, Florida

Well ID	Northing	Easting	Ground Elev. (ft msl)	Top of Casing (ft msl)	Casing Stick-up	Total Depth (ft bls)	Screen Top (ft bls)	Screen Bottom (ft bls)	Screen Type	Well Diameter
EPA-9D	636,768	913,911	3.30	3.22	-0.03	141.00	129.00	139.00	0.02	2
EPA-10S	639,051	915,511	7.90	7.95	0.01	61.00	50.00	60.00	0.02	2
EPA-10D	639,090	915,452	8.00	7.91	-0.11	141.00	130.00	140.00	0.02	2
EPA-11D	635,971	915,757	5.60	5.36	-0.24	141.00	129.60	139.60	0.02	2
EPA-12S	639,622	914,437	4.90	4.88	-0.01	61.00	50.50	60.50	0.02	2
EPA-14S	635,689	913,664	3.20	3.08	-0.14	61.00	50.00	60.00	0.02	2
EPA-14D	635,666	913,664	3.10	2.99	-0.06	141.00	130.00	140.00	0.02	2
EPA-15S	634,461	914,091	6.40	6.34	-0.06	59.00	49.00	59.00	0.02	2
EPA-15D	634,462	914,097	6.20	5.90	-0.30	138.50	128.00	138.00	0.02	2
EPA-16S	636,442	913,258	5.30	5.40	0.10	60.00	50.00	60.00	0.02	2
EPA-16D	636,429	913,258	5.50	5.23	-0.27	139.00	129.00	139.00	0.02	2
EPA-17S	635,403	914,428	5.70	8.79	3.09	63.00	50.00	60.00	0.02	2
EPA-17D	635,402	914,432	5.70	8.69	2.99	143.50	132.00	142.00	0.02	2
EPA-18S	634,645	915,689	6.10	5.95	-0.15	57.00	47.00	57.00	0.02	2
EPA-18D	634,645	915,703	5.80	5.58	-0.22	140.00	130.00	140.00	0.02	2
EPA-19D						140.50	130.00	140.00	0.02	2
EPA-20D	Wells installed 1/98 to be surveyed as part of additional well installation activities planned to occur after production of RI Report					136.00	125.50	135.50	0.02	2
EPA-21S						60.50	50.00	60.00	0.02	2

Table 4-3
Construction Details for Piezometers and Monitoring Wells
Florida Petroleum Reprocessors, Davie, Florida

Well ID	Northing	Easting	Ground Elev. (ft msl)	Top of Casing (ft msl)	Casing Stick-up	Total Depth (ft bls)	Screen Top (ft bls)	Screen Bottom (ft bls)	Screen Type	Well Diameter
EPA-21D						140.50	130.00	140.00	0.02	2
EPA 22D						140.00	129.50	139.50	0.02	2
On-Site Well Clusters										
EPAMP-01D	636,569	913,734	6.40	6.24	0.16	140.60	130.00	140.00	0.02	2
EPAMP-01I	636,570	913,737	6.40	6.18	0.22	101.60	90.50	100.50	0.02	2
EPAMP-01S	636,570	913,737	6.40	6.17	0.23	59.60	49.00	59.00	0.02	2
EPAMP-01VS	636,570	913,737	6.40	6.07	0.33	30.30	20.00	30.00	0.02	2
EPAMP-02D	636,504	913,666	7.00	6.86	0.14	140.60	129.50	139.50	0.02	2
EPAMP-02I	636,506	913,662	7.20	7.02	0.18	100.70	90.00	100.00	0.02	2
EPAMP-02S	636,506	913,662	7.20	7.00	0.20	60.70	50.00	60.00	0.02	2
EPAMP-02VS	636,509	913,660	7.20	7.00	0.20	30.50	20.00	30.00	0.02	2
EPAMP-03D	636,386	913,777	5.90	5.66	0.24	140.40	129.00	139.00	0.02	2
EPAMP-03I	636,388	913,779	6.00	5.66	0.34	100.50	89.00	99.00	0.02	2
EPAMP-03S	636,382	913,782	5.90	5.55	0.35	59.50	49.50	59.50	0.02	2
EPAMP-03VS	636,384	913,785	5.90	5.65	0.25	30.40	19.50	29.50	0.02	2
On-Site Existing Wells (Installed by Southeast Environmental Consultants, Inc.)										
MW-4	636,530	913,704	7.10	6.85	Flush	12.00	2.00	12.00	0.02	2
MW-5	636,532	913,704	7.20	7.18	Flush	445.00	35.00	45.00	0.02	2
MW-18	636,554	913,791	6.60	6.48	Flush	13.00	3.00	13.00	0.02	2

Table 4-3
Construction Details for Piezometers and Monitoring Wells
Florida Petroleum Reprocessors, Davie, Florida

Well ID	Northing	Easting	Ground Elev. (ft msl)	Top of Casing (ft msl)	Casing Stick-up	Total Depth (ft bls)	Screen Top (ft bls)	Screen Bottom (ft bls)	Screen Type	Well Diameter
MW-22	636,558	913,711	6.60	6.48	Flush	13.00	3.00	13.00	0.02	2
MW-25	636,454	913,685	6.50	6.17	Flush	12.20	2.00	12.00	0.02	2
Soil Boring Piezometers										
EPASB-07	636,538	913,710	7.40	7.75	0.48	9.80	0.30	9.60	0.02	2
EPASB-08	636,523	913,699	7.10	7.55	0.52	9.80	0.30	9.60	0.02	2
EPASB-09	636,529	913,677	7.10	7.72	0.55	9.80	0.20	9.60	0.02	2
EPASB-10	636,503	913,693	6.80	7.26	0.42	9.90	0.40	9.70	0.02	2
EPASB-11	636,554	913,716	6.40	6.90	0.45	9.80	0.30	9.60	0.02	2
Temporary Water Table Piezometers										
EPA-PZ01	636,568	913,671	7.10	7.53	0.50	7.60	1.60	7.60	Saw Slotted	1
EPA-PZ02	636,516	913,664	7.00	8.12	1.20	9.10	3.90	8.90	0.02	1
EPA-PZ03	636,455	913,659	6.40		1.45	8.80	3.60	8.60	0.02	1
EPA-PZ04	636,419	913,716	6.30	7.90	1.54	8.80	3.60	8.60	0.02	1
EPA-PZ05	636,376	913,775	5.90	8.03	2.14	8.20	3.00	8.00	0.02	1
EPA-PZ06	636,453	913,770	6.10	9.71	3.83	6.50	1.30	6.30	0.02	1
EPA-PZ07	636,494	913,781	6.40		1.61	8.70	3.50	8.50	0.02	1
EPA-PZ08	636,552	913,799	5.80	7.30	1.64	8.70	3.50	8.50	0.02	1
EPA-PZ09	636,555	913,756	6.00	6.05	0.05	8.80	3.60	8.60	0.02	1
EPA-PZ10	636,531	913,710	7.10	11.31	4.25	6.00	0.80	5.80	0.02	1

Table 4-3
Construction Details for Piezometers and Monitoring Wells
Florida Petroleum Reprocessors, Davie, Florida

Well ID	Northing	Easting	Ground Elev. (ft msl)	Top of Casing (ft msl)	Casing Stick-up	Total Depth (ft bls)	Screen Top (ft bls)	Screen Bottom (ft bls)	Screen Type	Well Diameter
EPA-PZ11	636,560	913,642	7.80	9.12	1.82	8.50	3.30	8.30	0.02	1
EPA-PZ12	636,501	913,736	6.40	7.93	1.45	8.80	3.60	8.60	0.02	1
EPA-PZ13	636,538	913,722	6.90	9.53	2.71	7.60	2.40	7.40	0.02	1
EPA-PZ14	636,524	913,718	7.00	9.64	2.70	7.60	2.40	7.40	0.02	1
EPA-PZ15	636,526	913,699	7.10	7.34	2.22	8.10	2.90	7.90	0.02	1
EPA-PZ16	636,541	913,708	7.30	8.81	1.52	8.80	3.60	8.60	0.02	1
EPA-PZ17	636,535	913,679	7.20	9.18	2.03	8.30	3.10	8.10	0.02	1
EPA-PZ18	636,532	913,745	6.30	7.91	1.70	8.60	3.40	8.40	0.02	1
EPA-PZI9	626,513	913,728	6.30	7.57	1.31	9.00	3.80	8.80	0.02	1
EPA-PZ20	636,552	913,724	6.30	7.95	1.67	8.60	3.40	8.40	0.02	1
EPA-PZ21	636,557	913,707	6.90	6.80	-0.10	8.70	3.50	8.50	0.02	1
EPA-PZ22	636,561	913,687	7.10	8.34	1.33	8.90	3.70	8.70	0.02	1
EPA-PZ23	636,547	913,683	7.20	8.67	1.46	8.80	3.60	8.60	0.02	1
EPA-PZ24	636,511	913,696	6.90	8.82	1.96	8.30	3.10	8.10	0.02	1
EPA-PZ25	636,513	913,677	7.10	8.55	1.55	8.60	3.40	8.40	0.02	1
EPA-PZ26	636,493	913,692	6.70	8.49	1.82	8.50	3.30	8.30	0.02	1
EPA-PZ27	636,506	913,714	6.70	8.22	1.50	8.80	3.60	8.60	0.02	1
EPA-PZ28	636,539	913,660	7.20	8.29	1.11	9.20	4.00	9.00	0.02	1
EPA-PZ29	636,590	913,651	7.20	10.27	3.18	7.10	1.90	6.90	0.02	1

Table 4-3
Construction Details for Piezometers and Monitoring Wells
Florida Petroleum Reprocessors, Davie, Florida

(Page 6 of 6)

Well ID	Northing	Easting	Ground Elev. (ft msl)	Top of Casing (ft msl)	Casing Stick-up	Total Depth (ft bls)	Screen Top (ft bls)	Screen Bottom (ft bls)	Screen Type	Well Diameter
Miscellaneous Off-Site Monitoring Wells (installed by others)										
FC-5						80.00	75.00	80.00	Open Hole	4
FC-6						150.00	145.00	150.00	Open Hole	4

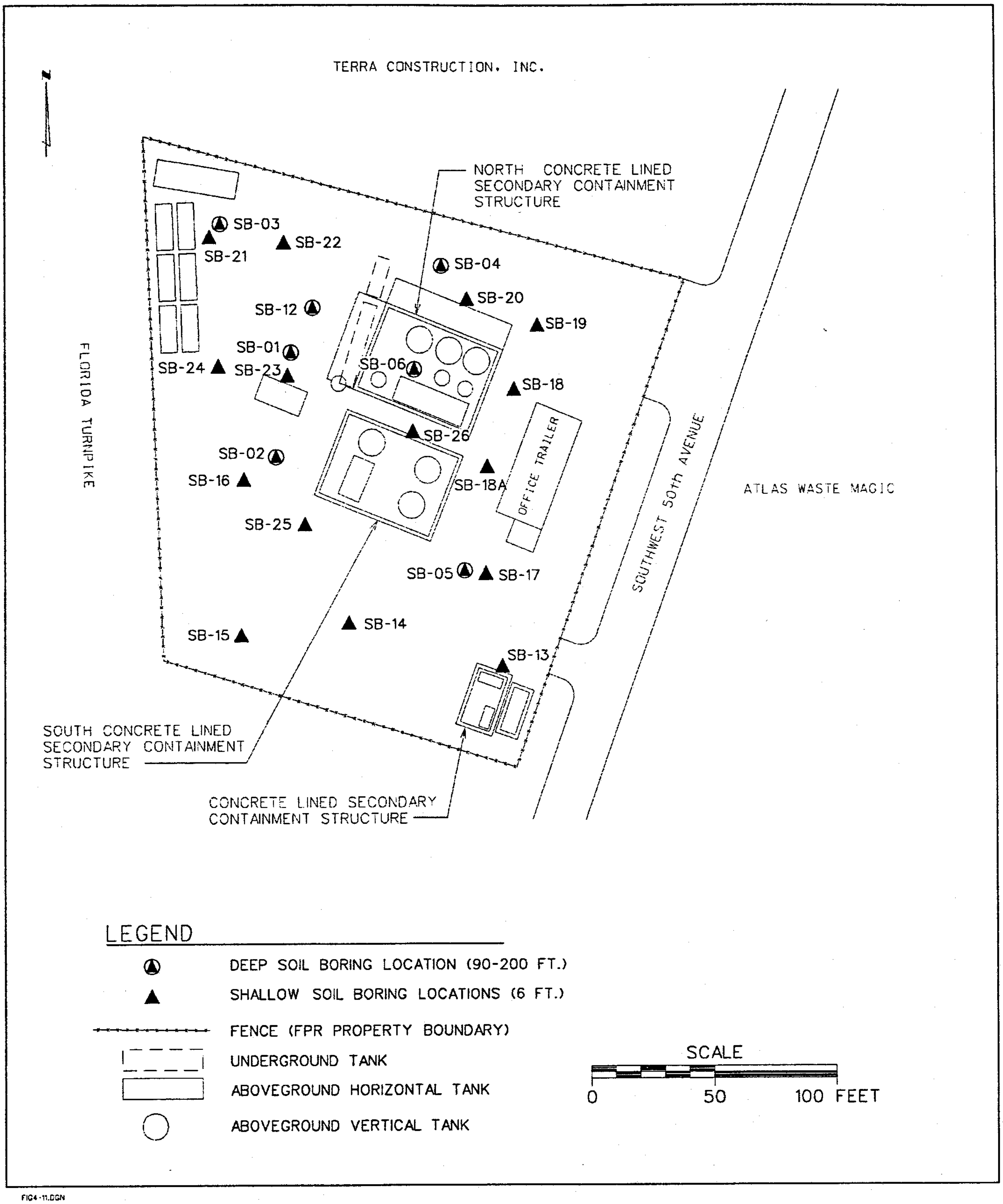


Figure 4-11
On-Site Soil Boring Locations
Florida Petroleum Reprocessors, Davie, Florida

Table 4-4
Summary of Field Screening Tests for Presence of DNAPL in Soil
Florida Petroleum Reprocessors, Davie, Florida

EPASB01

Depth	Field Screening Tests: Visual Staining	UV Fluor.	Soil/Water Shake	Hydroph. Dye	Head Space	Evidence for DNAPL: Slight — Strong
7-9	Yes	No	No	No	220	
12-14	Yes	Yes	Possible	Yes	500	
17-19	No	Yes	No	No	50	
22-24	Yes	No	No	No	5	
27-29	No	Yes	No	No	2	
32-34	No	No	No	No	7	
37-39	Yes	No	No	Yes	800	
42-44	No	Yes	No	Yes	1000	
47-49	No	No	No	No	200	
52-54	No	No	No	No	20	
57-59	Yes	Yes	No	Yes	1000	
62-64	Yes	No	No	No	250	
67-69	Yes	No	No	No	40	
72-74	Yes	Yes	Possible	Possible	40	
77-79	Yes	Yes	Possible	Possible	30	
82-84	No	Yes	No	Possible	35	
87-89	No	No	No	No	600	
92-94	No	No	No	No	20	
97-99	No	No	No	No	60	
102-104	No	No	No	No	60	
108-218	No	No	No	No	1-280	

EPASB12

Depth	Field Screening Tests: Visual Staining	UV Fluor.	Soil/Water Shake	Hydroph. Dye	Head Space	Evidence for DNAPL: Slight — Strong
1-3	Yes	Yes	No	No	800	
3-5	Yes	Yes	No	No	1000	
5-7	No	Yes	No	No	100	
7-9	No	No	No	No	300	
9-11	No	Yes	No	No	200	
11-14	No	No	No	No	100	
13-15	No	Yes	No	No	80	
15-17	No	No	No	No	50	
17-19	No	No	No	No	30	
20-22	No	No	No	No	18	
22-24	No	No	No	No	38	
24-26	No	No	No	No	100	
26-28	No	No	No	No	18	
28-30	No	No	No	No	88	
30-32	No	No	No	No	40	
32-34	No	No	No	No	8	
35-37	No	Yes	No	No	150	
37-39	No	No	No	No	1000	
39-41	No	Yes	No	No	1000	
41-43	No	Yes	No	No	1000	
43-45	No	Yes	No	No	1000	
45-47	No	Yes	No	No	1000	
47-49	Yes	Yes	No	Yes	400	
49-51	Yes	No	No	No	80	
51-53	Yes	No	No	No	100	
53-55	Yes	Yes	No	No	70	
55-57	Yes	Yes	No	No	100	
57-59	No	Yes	No	No	20	
59-61	Yes	Yes	No	No	82	
61-63	Yes	Yes	Possible	Possible	80	
63-65	Yes	Yes	No	No	40	
67-69	Yes	Yes	No	No	30	
71-73	No	No	No	No	25	
75-77	No	No	No	No	48	
79-81	No	No	No	No	50	
83-85	No	No	No	No	20	
88-90	No	Yes	No	No	120	

Note:
1. Test methods and evaluation based on methodology presented in *DNAPL Site Evaluation Manual*, EPA/600/R-93/022, February 1993.
2. Complete screening test results for all soil samples are presented in the 1998 RI report by Bechtel.
3. UV Fluor. - ultraviolet fluorescence; Hydroph. Dye - hydrophobic dye.
4. All depth intervals are in feet below land surface (bls).

Table 4-5
Evaluation of Potential Indicator of DNAPL
Florida Petroleum Reprocessors, Davie, Florida

Compound	Solubility	1% Solubility	Maximum Detected Concentration: Water Table Interval (4-12 ft bls)	Shallow Interval (50-60 ft bls)	Intermediate Interval (90-100 ft bls)	Deep Interval (130-140 ft bls)	Sampling Locations w/ >1% Solubility
PCE	400,000	4,000	260	ND	ND	ND	--
TCE	1,000,000	10,000	200,000	4	30	10	PZ15, SB08
1,1,1-TCA	950,000	9,500	140,000	350	530	ND	PZ15, PZ16, PZ24, PZ25, SB08, MW4
1,1-DCA	4,962,000	49,620	30,0000	66	49	22	--
1,2-DCE	3,500,000	35,000	270,000	690	920	1,200	PZ15, PZ16, PZ17, PZ24, PZ25, SB08, SB09, MW4
1,1-DCE	400,000	4,000	9,800	89	190	200	SB08, MW4
Vinyl Chloride	90,000	900	18,000	320	650	240	PZ01, PZ14, PZ16, PZ17, PZ19, PZ21, PZ22, PZ24, SB07, SB09, SB10, MW4
Chlorethane	5,740,000	57,400	4,800	17	3.8	3	--

Notes:
1. All concentrations in μg/L (ppb).
2. No concentrations greater than 1% of solubility were detected in the shallow, intermediate, or deep zones of the Biscayne aquifer in either on-site or off-site monitoring wells; hence, no locations are provided.
3. Maximum concentrations based on March-April 1997 and January 1998 sampling events completed for the 1998 RI report by Bechtel.
4. Solubility values derived from Table 5-1 of the 1998 RI report by Bechtel.
5. The 1% solubility criterion is widely recognized as evidence indicating potential for DNAPL as presented in *DNAPL Site Evaluation*, EPA/600/R-93/022, February 1993; *Estimating Potential for Occurrence of DNAPL at Superfund Sites*, EPA Publication 9355.4-07FS, January 1992; and *DNAPL Site Diagnosis and Remediation*, University Consortium Solvents-in-Groundwater Research Program, Waterloo Centre for Groundwater Research, October 1995.

As a result of questions raised, however, by a group of PRPs for the FPR Site regarding the sample collection methods utilized in the investigation of the DNAPL by EPA, the Group installed two additional borings in the source area to further investigate the potential presence of a DNAPL and the vertical extent of contamination. These results are summarized in Table 4-6. A complete report of the PRP findings is included in the AR for this Site. While the results do not show the same magnitude of contamination as EPA's findings, they show a similar contaminant distribution and are viewed by EPA to be consistent with the vertical migration of a DNAPL.

EPA contracted with the Department of Energy, Idaho National Engineering and Environmental Laboratory (INEEL), to conduct an independent review of the evidence regarding the presence of a DNAPL. Most notably, INEEL conducted an assessment of the maximum concentration of VOCs that could be expected to be present in the soil and groundwater as a result of a release of a non-DNAPL (i.e., aqueous-phase) waste. INEEL concluded there was strong evidence for the presence of DNAPL in groundwater samples collected to a depth of 12 feet bgs and strong evidence of DNAPL soil samples collected to a depth of 50 to 60 feet bgs. A summary of these results is provided in Tables 4-7 and 4-8. A complete report of INEEL's findings is included in the AR for this Site.

An additional DNAPL study was completed in January 2000 by Golder Associated on behalf of the PRP Group. The investigation involved the installation of 18 boreholes to an approximate depth of 60 feet bgs. Figure 4-12 depicts the location of the boreholes and collection intervals. Approximately 400 samples were collected and analyzed for the presence of DNAPL. The study documented the presence of a zone of residual DNAPL in the subsurface, primarily in a zone ranging from 34 to 43 feet bgs, in a localized area in the northwest portion of the Site. At one location, evidence of residual DNAPL extended to a depth of 59 feet bgs. Figure 4-13 illustrates the distribution of residual DNAPL detected by Golder Associates. The complete results of this study are documented in the January 200 DNAPL investigation report for the FPR Site, prepared by Golder Associates.

Based on these results and the threat posed to the aquifer, it was determined that the residual DNAPL would be addressed through a removal action. The removal action involves in-situ treatment of the residual DNAPL through chemical oxidation. The action started in August 2000, and is expected to take approximately 6 months to complete.

Shallow Soil Investigation

Evaluation of the results of shallow soil samples (i.e., 0 to 12 feet bgs) collected during the RI indicated that four classes of contaminants exist in the source area soils: VOCs, extractable semivolatile organic compounds (SVOCs), metals, and pesticides/polychlorinated compounds (PCBs). As discussed previously, the shallow contaminated soils were removed in mid-1999. The follow discussion is presented for background purposes only.

Table 4-6
TVOC Concentrations in Soil Source Area
Florida Petroleum Reprocessors, Davie, Florida

General Geology	Interval (ft bls)	SB02		SB03		SB06		SB01		SB12		FPRSB01		FPRSB12	
		TVOC	*Depth*	TVOC	*Depth*	TVOC	*Depth*	TVOC	*Depth*	TVOC	*Depth*	TVOC	*Depth*	TVOC	*Depth*
Sand	0-5	ND	*5*			132	*2*								
	6-10			108	*6*	ND	*6*					235.580	*6*	17,880	*6*
				722	*8*	59	*8*							12.060	*10*
				ND	*10*	ND	*10*								
	11-15	ND	*11*	ND	*12*	ND	*12*			569	*11*	26.454	*12*		
				5	*14*	18	*16*			ND	*13*				
	16-20	ND	*19*	10	*18*	ND	*18*					4.914	*18*		
Oolitic LS	21-25	48	*23*	88	*20*	18	*22*	9.980	*23*	513	*22*	4	*24*	140	*22*
		1.037	*25*	6	*22*	21	*26*			113	*24*				
				ND	*24*	9	*30*								
	26-30	174	*29*	ND	*26*			210	*28*	14	*26*	1.669	*28*	27	*28*
Sand and Calcareous SS										408	*28*				
										157	*30*				
	31-35	ND	*35*	ND	*30*					255	*32*	143	*32*	ND	*32*
				ND	*32*					175	*34*				
				ND	*34*										
	36-40			ND	*36*	ND	*38*	5,223	*38*	188	*39*	10	*38*	187	*38*
	41-45	ND	*41*			ND	*44*	105.600	*43*	10,312	*41*			10	*44*
										120,400	*43*				
										1,170,60	*45*				
	46-50	ND	*47*	ND	*46*	ND	*50*			9,997	*47*	ND	*46*	474	*50*
										22,775	*49*				
Key Largo LS	51-55	6	*53*					5,000	*53*	249	*51*	28	*54*	ND	*56*
										410	*53*				
	56-60			ND	*60*	ND	*56*	20,600	*58*	144	*57*	252	*60*		
										136	*59*				
	61-65	ND	*61*			24	*62*			948	*61*			ND	*62*
										51	*63*				
										113	*65*				
Calcar. SS	66-70	7	*67*	ND	*66*	53	*66*			34	*69*	252	*68*	ND	*68*
				ND	*68*	11	*68*								
				ND	*70*										
	71-75	33	*73*			ND	*74*	720	*73*	ND	*73*	41	*73*	ND	*72*
	76-80	ND	*79*	ND	*80*	ND	*80*			4	*77*			ND	*78*
Anastasia SS	81-85	ND	*85*	ND	*82*					40	*81*	ND	*82*	ND	*84*
				ND	*84*										
	86-90	ND	*89*	ND	*86*	11	*86*			627	*90*	3	*89*	ND	*90*
	91-95	77	*92*												
	96-100	81	*97*	ND	*97*										
	101-105	11	*102*	ND	*102*			692	*103*						
	>106							5	*133*						
								ND	*153*						
								6	*178*						
								11	*213*						

All concentrations in µg/kg. TVOC = Total chlorinated VOCs. LS = Limestone.
Depth shown for each sample is bottom of sampling interval. SS = Sandstone.
ND - not detected. Calcar. = Calcareous.
Sample with TVOC > 200 µg/kg.

Table 4-7
Comparison of Aqueous-Phase Concentrations to Pure-Phase Solubility
Florida Petroleum Reprocessors, Davie, Florida

(Page 1 of 2)

Compound	1,1,1-TCA	TCE	1,1-DCA	1,1-DCE	cis-1,2-DCE	Vinyl Chloride
Pure-Phase Solubility, C_{sat} (mg/L)	950	1,000	4,962	400	3,500	90
0.01 × C_{sat} (µg/L)	9,500	10,000	49,620	4,000	35,000	900
Sample Location	Observed Concentrations (µg/L)					
Shallow Depth (4 to 12 ft bls)						
MW-4	43,000	1,100	16,000	4,200	130,000	10,000
MW-12						
MW-22						
MW-25						
PZ-01	26		160	16		
PZ-02	180	94	2,150		370	180
PZ-09						
PZ-11			27			
PZ-12						
PZ-13		37	240		20	
PZ-14	2,200	220	13,500		1,750	260
PZ-15	100,000	100,000	21,000		270,000	
PZ-16	24,500	1,000	22,000	1,400	68,000	17,000
PZ-17	2,300		13,500	370	22,000	12,000
PZ-18		11			22	
PZ-19	235	38	4,600			
PZ-20			21		23	
PZ-21						
PZ-22			7		13	
PZ-23	270		560		330	430
PZ-24	32,500		30,000	3,200	130,000	15,000
PZ-25	18,000	75	15,000	510	41,000	4,500

Table 4-7
Comparison of Aqueous-Phase Concentrations to Pure-Phase Solubility
Florida Petroleum Reprocessors, Davie, Florida

Compound	1,1,1-TCA	TCE	1,1-DCA	1,1-DCE	cis-1,2-DCE	Vinyl Chloride
Pure-Phase Solubility, C_{sat} (mg/L)	950	1,000	4,962	400	3,500	90
0.01 × C_{sat} (µg/L)	9,500	10,000	49,620	4,000	35,000	900
Sample Location	Observed Concentrations (µg/L)					
PZ-26	160		2,950	180	130	160
PZ-27	400	6	2,000		92	
SB-07	7,400	770	5,550	420	20,000	4,400
SB-08	140,000	200,000	18,000	9,800	260,000	3,750
SB-09	2,400		10,850	200	30,500	14,000
SB-10	4,200		16,500	160	18,000	6,300
SB-11	14	38	29		14	
Intermediate Depth (20 to 45 ft bls)						
EPAMP-1VS	1	6	28		2	3
EPAMP-2VS			95		8	
MW-5	110	20	250	12	690	150
Great Depth (Greater than 45 ft bls)						
EPAMP-1S	72	2	28	17	120	106
EPAMP-1I	315	30	42	180	630	350
EPAMP-1D		8	23	215	1,200	230
EPAMP-2S	340	4	64	89	660	300
EPAMP-2I	110	6	39	53	185	280
EPAMP-2D		1	2		24	4

Notes:
1. Concentration data are taken from Appendix R of the draft RI report (Bechtel, 1997). In cases where multiple values are shown in the appendix, the tabulated value is the arithmetic average unless there was a data qualifier flag associated with one value, in which case the unflagged value is tablulated.
2. Tabulated values for 1,2-DCE are cis-1,2-DCE if values were reported for both cis- and total 1,2-DCE, and are total 1,2-DCE otherwise. Typically, when values for both cis- and total 1,2-DCE were reported, the cis- isomer was at least 90 percent of the total. In general, values for total only were reported when concentrations were low, and both cis- and total 1,2-DCE were reported when concentrations were high.
3. The depth category classification was taken from the draft RI report (Bechtel, 1997, pp. 4-15 and 4-41).
4. TCA = Trichloroethane.
5. TCE = Trichloroethene.
7. DCA = Dichloroethane.
8. DCE = Dichloroethene.

Table 4-8
Comparison of Chlorinated VOCs in Soil Samples
Florida Petroleum Reprocessors, Davie, Florida

(Page 1 of 4)

Sample	Depth	PCE	TCE	1,1,1-TCA	1,2-DCE	1,1-DCA	Benzene	Toluene	EthBz	Tot. Xyl.
0 - 2 ft Sampling Interval										
PZ28-01	0-2 ft	--	--	9	--	11	--	--	--	--
SB12-01	1-3 ft	**9,800**	80,000	87,000	25,000	2,400	--	--	--	--
SB21-01	0-2 ft	29	--	--	--	--	--	39	220	--
SB23-01	0-2 ft	--	18,000	**14,000**	3,600	--	--	--	--	--
2 - 4 ft Sampling Interval										
PZ10-02	2-4 ft	22	310	180	--	6	--	--	--	--
PZ15-01	2-2.5 ft	95	44,000	**13,000**	350	36	--	--	--	--
PZ15-02	3-4 ft	2,100	**220,000**	37,000	4,100	--	--	13,000	--	2,600
PZ16-01	2-2.5 ft	1,400	120	**11,000**	8,000	1,400	--	--	--	--
PZ16-02	2-4 ft	**4,300**	160	39,000	19,000	3,600	--	--	--	--
PZ17-02	2-4 ft	110	2,800	**13,000**	6,400		--	--	--	--
PZ23-02	2-4 ft	360	72	3,900	540	530	--	--	--	--
PZ24-02	2-4 ft	600	**9,300**	32,000	10,000	460	--	--	--	--
PZ25-02	2-4 ft	--	12	82	100	--	--	--	--	--
PZ26-02	2-4 ft	--	--	16	6	6	--	--	--	--
PZ27-02	2-4 ft	190	25	260	52	81	--	--	--	--
PZ28-02	2-4 ft	15	--	42	--	63	--	--	--	--
SB12-02	3-5 ft	**5,900**	42,000	64,000	24,000	2,500				
SB21-02	2-4 ft	**120,000**	1,600	1,300	29,000	7,400	1,300	60,000	13,000	--
SB23-02	2-4 ft	**5,200**	**220,000**	67,000	6,900	--	--	28,000	3,000	37,000
Hits /19		15	15	18	15	13	1	4	3	2
Min		15	12	9	6	6	1,300	39	220	2,600
Max		120,000	220,000	87,000	29,000	7,400	1,300	60,000	13,000	37,000

Table 4-8
Comparison of Chlorinated VOCs in Soil Samples
Florida Petroleum Reprocessors, Davie, Florida

Sample	Depth	PCE	TCE	1,1,1-TCA	1,2-DCE	1,1-DCA	VC	Toluene	EthBz	Tot. Xyl.
4 - 6 ft Sampling Interval										
SB07-03	4-6 ft	2,200	140	3,400	2,700	--	--	2,800	780	3,100
SB08-03	4-6 ft	**9,700**	**620,000**	**270,000**	26,000	--	--	82,000	4,800	21,000
SB09-03	4-6 ft	--	--	10	58	75	10	--	--	--
SB10-03	4-6 ft	--	--	**16,000**	1,600	660	--	--	1,000	7,400
SB21-03	4-6 ft	**12,000**	--	1,400	2,500	1,600	--	38,000	7,100	--
SB23-03	4-6 ft		**610,000**	**490,000**	90,000	--	--	44,000	--	--
PZ10-03	4-6 ft	7	130	110	41	--	--	--	--	--
PZ16-03	4-6 ft	**5,300**	230	35,000	12,000	2,100	--	--	--	--
PZ17-03	4-6 ft	--	26	110	93	26	--	--	--	--
PZ23-04	4-6 ft	44	--	140	68	110	--	--	--	--
PZ24-03	4-6 ft	2,600	57,000	**310,000**	97,000	8,700	--	--	--	--
PZ14-02	5-5.5 ft	260	1,000	4,700	490	1,100	--	--	--	--
PZ15-03	5.5-6 ft	400	32,000	**6,500**	1,300	66	--	--	--	--
SB12-3	5-7 ft	9	50	160	1,300	160	--	--	--	--
6 - 8 ft Sampling Interval										
SB08-04	6-8 ft	1,000	**14,000**	**13,000**	47,000	3,200		15,000	850	3,500
PZ10-04	6-8 ft	840	580	860	380	160	--	--	--	--
PZ17-04	6-8 ft	15	30	130	66	39	--	--	--	--
PZ25-04	6-8 ft	--	--	--	19,000	4,900	--	--	--	--
PZ27-04	6-8 ft	64	21	49	4	--	--	--	--	--
PZ15-04	7-7.5 ft	890	96,000	33,000	12,000	960	--	--	--	--
PZ16-04	7.5-8 ft	**11,000**	370	**12,000**	41,000	11,000	--	--	--	--
SB12-04	7-9 ft	76	600	2,700	1,400	160	--	--	--	--
8 - 10 ft Sampling Interval										
PZ14-03	8-8.5 ft	450	350	3,400	350	4,100	--	--	--	--
PZ15-05	8.5-9 ft	1,200	110,000	41,000	17,000	1,200	--	--	--	--
SB07-05	8-10 ft	700	--	3,300	2,900	1,200	--	950	180	720
SB08-05	8-10 ft	--	3,100	**7,100**	2,000	--	--	2,900	270	1,300
SB09-05	8-10 ft	--	--	--	18	4	--	--	--	--
SB10-05	8-10 ft	--	--	98	360	570	110	--	--	--
PZ17-05	8-10 ft		54	--	--	--	570	--	--	--
PZ16-05	8-10 ft	**11,000**	360	120,000	42,000	13,000	--	--	--	--
PZ24-05	8-10 ft	--	**6,600**	--	-	3,700	--	--	--	--
PZ25-06	8-10 ft	--	--	**16,000**	9,000	1,400	--	--	--	--
PZ26-05	8-10 ft	1,500	--	1,700	--	140	--	--	--	--
PZ27-05	8-10 ft	66	15	58	15	7	--	--	--	--
SB12-5	9-11 ft	--	27	120	140	59	--	--	--	--
10 - 12 ft Sampling Interval										
PZ24-06	10-12 ft	--	**6,400**	--	--	3,800	--	--	--	--
PZ14-04	10-11 ft	500	570	3,600	500	1,500		1,100	220	1,180
PZ17-06	10-12 ft	--	86	--	--	--	360	--	--	--
PZ23-06	10-12 ft	120	18	1,000	410	610	--	--	--	--
PZ16-06	11.5-12 ft	**5,300**	--	--	--	6,700	--	--	--	--
SB12-06	11-13 ft	--	17	110	360	87	--	--	--	--
Hits /41		26	30	34	35	33	4	8	8	7
Min		7	15	10	4	4	10	950	180	720
Max		12,000	620,000	490,000	97,000	13,000	570	82,000	7,100	21,000

Table 4-8
Comparison of Chlorinated VOCs in Soil Samples
Florida Petroleum Reprocessors, Davie, Florida

Sample	Depth	PCE	TCE	1,1,1-TCA	1,2-DCE	1,1-DCA	1,1-DCE	VC	Toluene	EthBz	Tot. Xyl.
12 - 15 ft Sampling Interval											
SB12-08	15-17 ft	--	42	6	62	12	--	--	--	--	--
SB12-09	17-19 ft	--	55	27	53	14	--	--	--	--	--
SB12-10	20-22 ft	--	33	30	260	60	8	9	2		
SB01-04	22-24 ft	2,200	740	5,000	1,400	320	320		2,600	620	2,400
SB12-11	22-24 ft	--	17	10	68	18	--	--	--	--	--
SB12-12	24-26 ft	--	3	2	6	3	--	--	--	--	--
25 - 40 ft Sampling Interval											
SB12-13	26-28 ft	28	200	87	26	--	--	--	--	--	--
SB01-05	27-29 ft	130	20	10	--	31	--	--	26	38	76
SB12-14	28-30 ft	--	28	61	36	32	--	--	--	--	--
SB12-15	30-32 ft	--	96	85	74	--	--	--	--	--	--
SB12-16	32-34 ft	--	50	66	59	--	--	--	--	--	--
SB12-17	35-37 ft	--	34	62	44	--	--	--	--	--	--
SB01-07	37-39 ft	32	2,200	660	1,600	460	250	21	910	12	52
SB12-18	37-39 ft	--	100	32	56	--	--	--	--	--	--
SB12-19	39-41 ft	780	880	--	--	52	--	--	--	--	--
40 - 50 ft Sampling Interval											
SB12-20	41-43 ft	1,000	98,000	**19,000**	2,400	--	--	--	--	--	--
SB01-08	42-44 ft		90,000	**12,000**	1,600	--	--	--	4,200	--	--
SB12-21	43-45 ft	1,900	**810,000**	**340,000**	17,000	1,700	--	--	--	--	--
SB12-22	45-47 ft	19	**5,900**	2,200	1,800	78	--	--	--	--	--
SB12-23	47-49 ft	110	**15,000**	**7,500**	130	35	--	--	--	--	--
SB12-24	49-51 ft	8	41	67	120	13	--	--	--	--	--
50 - 60 ft Sampling Interval											
SB12-25	51-53 ft	4	160	190	52	4	--	--	--	--	--
SB01-10	52-54 ft	--	--	--	5,000	--	--	--	--	--	--
SB12-27	55-57 ft	--	47	82	15	--	--	--	--	--	--
SB01-11	57-59 ft	700	--	**17,000**	1,900	--	--	--	2,100	--	360
SB12-28	57-59 ft	--	47	81	8	--	--	--	--	--	--
SB12-29	59-61 ft	--	390	230	52	5	13	7	--	--	--
60 - 80 ft Sampling Interval											
SB12-30	61-63 ft	--	28	18	5	--	--	--	--	--	--
SB12-31	63-65 ft	--	24	40	9	--	--	--	--	--	--
SB12-32	67-69 ft	--	6	--	28	--	--	--	--	--	--
SB12-33	71-73 ft	--	--	--	--	--	--	--	--	--	--
SB01-14	72-79 ft	29	11	11	19	--	--	--	--	--	--
SB12-34	75-77 ft	--	4	--	--	--	--	--	--	--	--
SB12-35	79-81 ft	--	2	7	6	--	--	--	--	--	--
> 80 ft Sampling Interval											
SB12-36	83-85 ft	--	--	--	--	--	--	--	--	--	--
SB12-37	88-90 ft	--	35	110	430	4	--	--	--	--	--
SB01-20	102-104 ft	--	13	3	42	2	--	--	2	--	--
SB01-26	132-134 ft	--	--	--	5	--	--	--	--	--	--
SB01-30	152-154 ft	--	--	--	--	--	--	--	--	--	--
SB01-35	177-179 ft	--	2	--	4	--	--	--	3	--	--
SB01-42	212-214 ft	--	5	--	6	--	--	--	3	--	--
SB01-43	217-219 ft	--	6	2	7	--	--	--	--	--	--
Hits /42		13	36	32	36	18	4	3	9	3	4
Min		4	2	2	4	2	13	7	2	12	52
Max		2,200	810,000	340,000	17,000	1,700	320	21	4,200	620	2,400

Notes:
1. All concentrations in µg/kg (ppb).
2. 1,1-DCE and vinyl chloride were not detected in soils from either 0 to 2 ft or 2 to 4 ft bls in the source area.
3. 1,1-DCE was detected in sample SB07-03 in a concentration of 15 µg/kg.
4. Chloromethane was detected in sample SB10-03 in a concentration of 780 µg/kg.

Table 4-8
Comparison of Chlorinated VOCs in Soil Samples
Florida Petroleum Reprocessors, Davie, Florida

5. – indicates compound was not detected.
6. VC = vinyl chloride; EthBz = ethyl benzene; Tot. Xyl. = total xylenes
7. Cl-VOC concentration categories:

PCE	TCE	1,1,1-TCA	Weight of Evidence Category
>3,000	>5,000	>5,000	Evidence for the presence of NAPL
>17,000	>29,000	>30,000	Strong evidence for the presence of NAPL
>110,000	>140,000	>160,000	Very strong evidence for the presence of NAPL

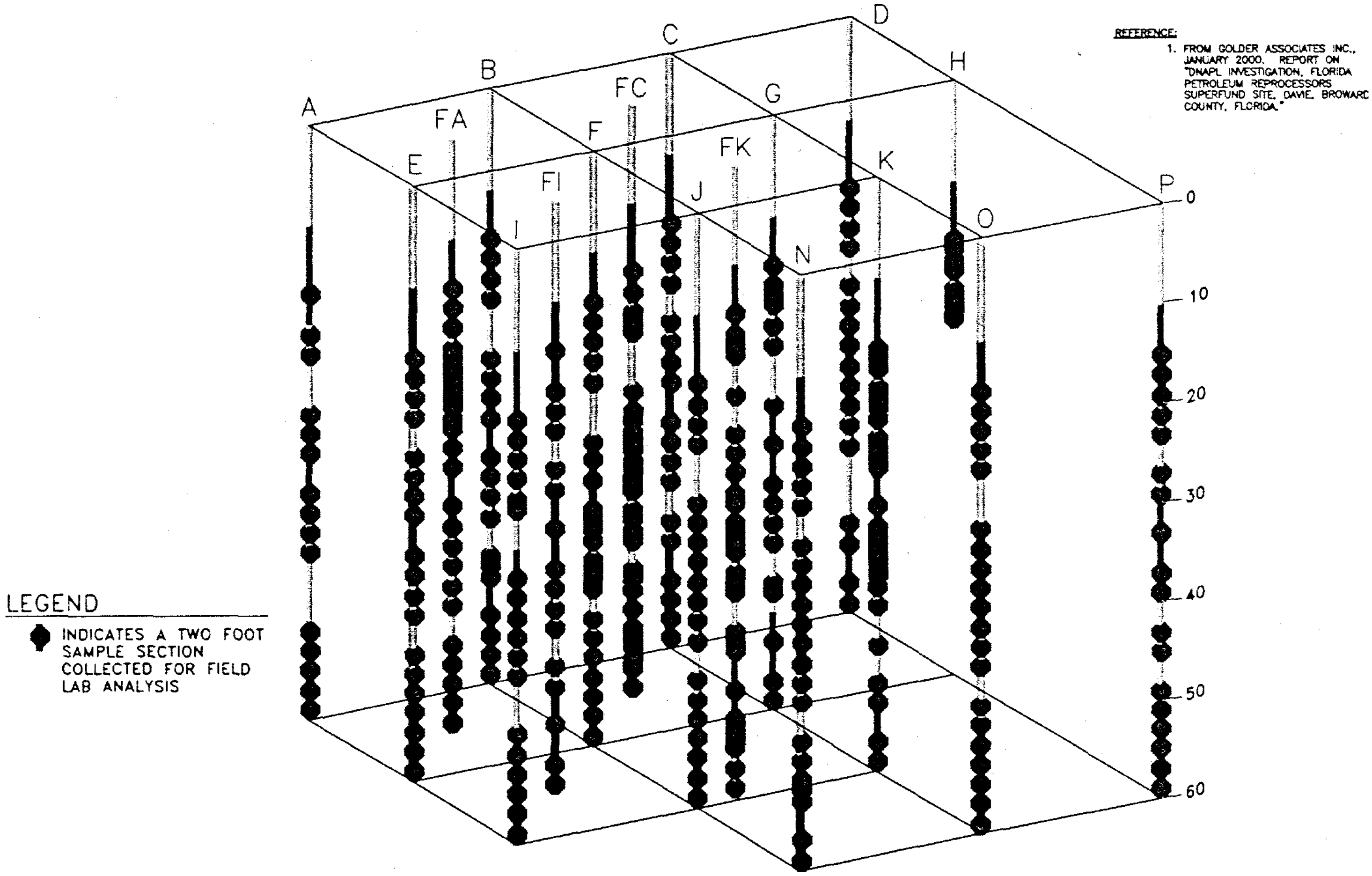
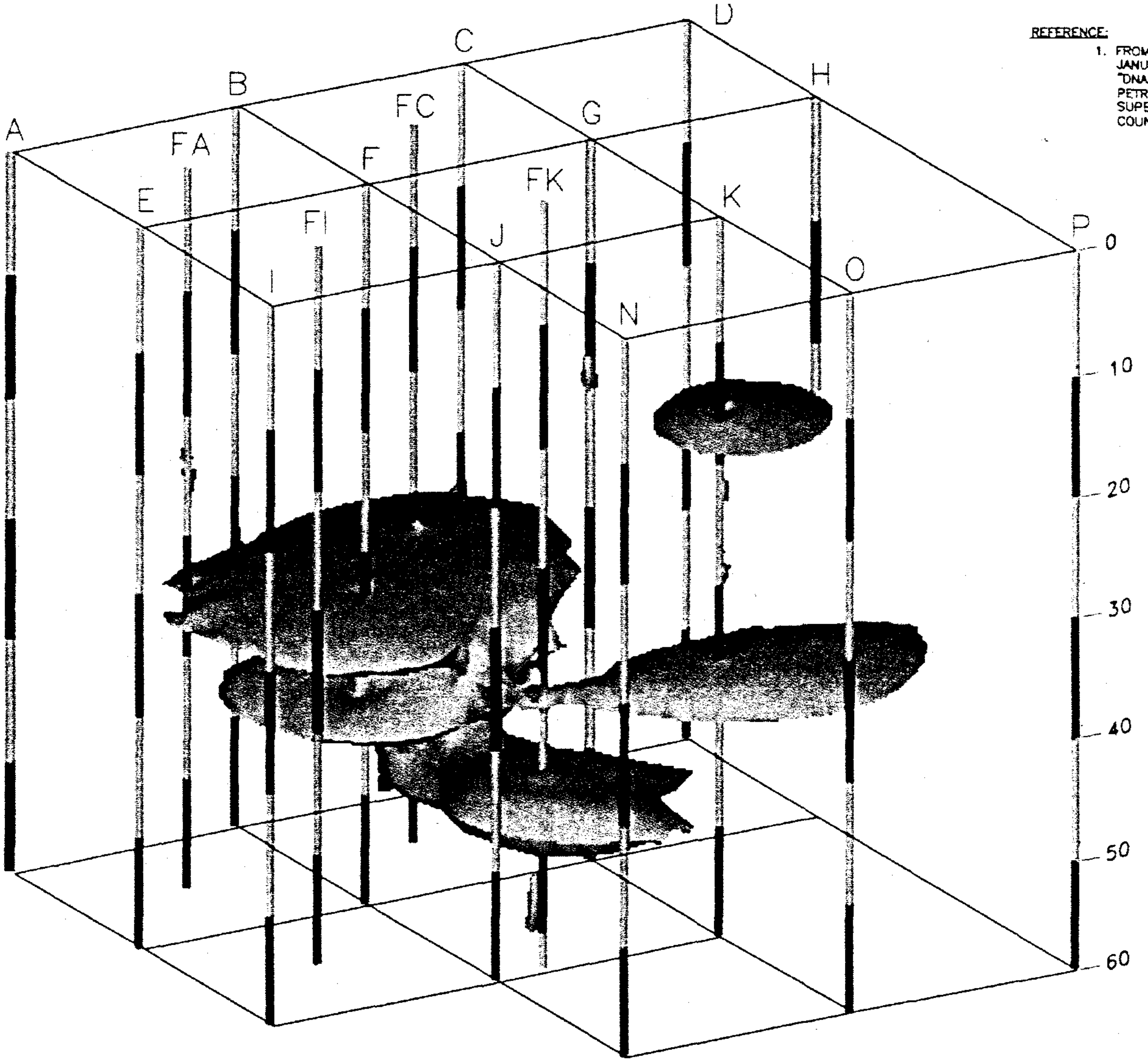


Figure 4-12
DNAPL Characterization of Soil Boring and Sample Locations
Florida Petroleum Reprocessors, Davie, Florida



REFERENCE:

1. FROM GOLDER ASSOCIATES INC., JANUARY 2000. REPORT ON "DNAPL INVESTIGATION, FLORIDA PETROLEUM REPROCESSORS SUPERFUND SITE, DAVIE, BROWAR COUNTY, FLORIDA."

Figure 4-13
Extent of Residual DNAPL
Florida Petroleum Reprocessors, Davie, Florida

More than 100 soil samples were collected to investigate the extent of shallow soil contamination. Figures 4-14 and 4-15 provide an overview of the distribution of contaminants that comprised the shallow source area soils, and shallow soil contamination that is not considered to be a part of the source area, respectively. In general, VOCs detected in the vadose zone were comprised of a larger percentage of parent compounds, including perchloroethene (PCE), TCE, and 1,1,1-TCA. With increasing depth, the percentage of degradation products increased. Degradation products 1,2-DCE and 1,1-dichloroethane (DCA) were the most commonly detected degradation products detected below the water table. As shown in Figure 4-14, total chlorinated VOCs concentrations exceeding 100,000 micrograms per kilograms (μg/kg) were not uncommon. The highest concentration for total VOCs (TVOCs) was 1,190,000 μg/kg in a sample collected in the vicinity of the former drop tank. In addition to the presence of chlorinated VOCs, other petroleum-related VOCs (i.e., benzene, toluene, ethyl benzene, and xylene [BTEX]) were detected at significant concentrations.

In general, metals and pesticides/PCBs detected were comparatively low in concentrations and frequencies of detection. Moreover, while metals are sometimes a component of waste oil, the metals represent a negligible component of the contamination. Minor levels of pesticides/PCBs are not considered to be site-related. The RI should be consulted for a full description of pesticide/PCB and metals contamination at the Site.

Petroleum Investigation

The investigation of petroleum contamination primarily included the collection and analyses of samples for extractable (semivolatile) organic compounds, tentatively identified compounds, and total petroleum hydrocarbons (TPH). Figure 4-16 shows the former spatial distribution of the contaminants of the extractable organic compounds, as well as tentatively identified compounds. Extractable organic compounds detected were comprised exclusively of polynuclear aromatic hydrocarbons (PAHs), which are common constituents of waste oil. The highest levels of PAHs were detected in the vicinity of the original tank farm and early waste oil transfer/storage operations. Contaminant levels increased with depth at a number of locations, as demonstrated by the presence of increasing amounts of waste oil contamination near the water table. A separate oil phase identified as an LNAPL was observed in two of the temporary wells installed in the northwest corner of the Site.

Analytical results from the analysis of samples for TPH and their relative distribution are depicted in Figure 4-17. The highest level of TPH detected during the investigation was from a sample collected from the northwest corner of the Site. Soil samples collected from this area were visibly contaminated with waste oil, with the highest TPH values exceeding 20,000 milligrams per kilogram. The higher TPH levels were also typically associated with increasing depth and proximity to the water table.

Petroleum contamination in this portion of the Site was most likely associated with an LNAPL plume of waste oil floating on the water table. The thickness of a discrete LNAPL layer was observed during the RI field investigation in piezometers PZ01, PZ11, PZ22, and PZ28, which varied from a thin film in PZ22 to 2.8 feet in PZ11. Although an LNAPL was not observed in

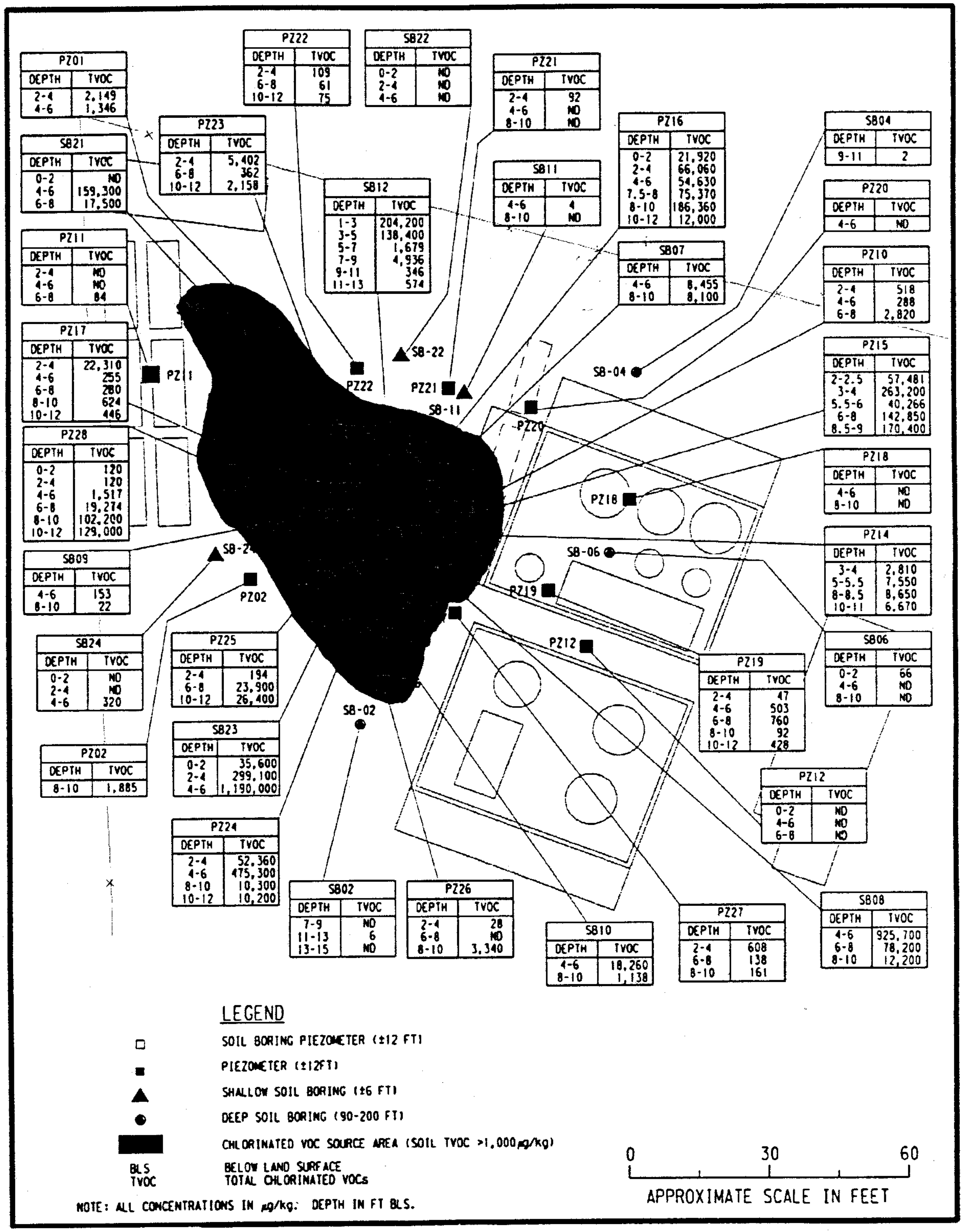
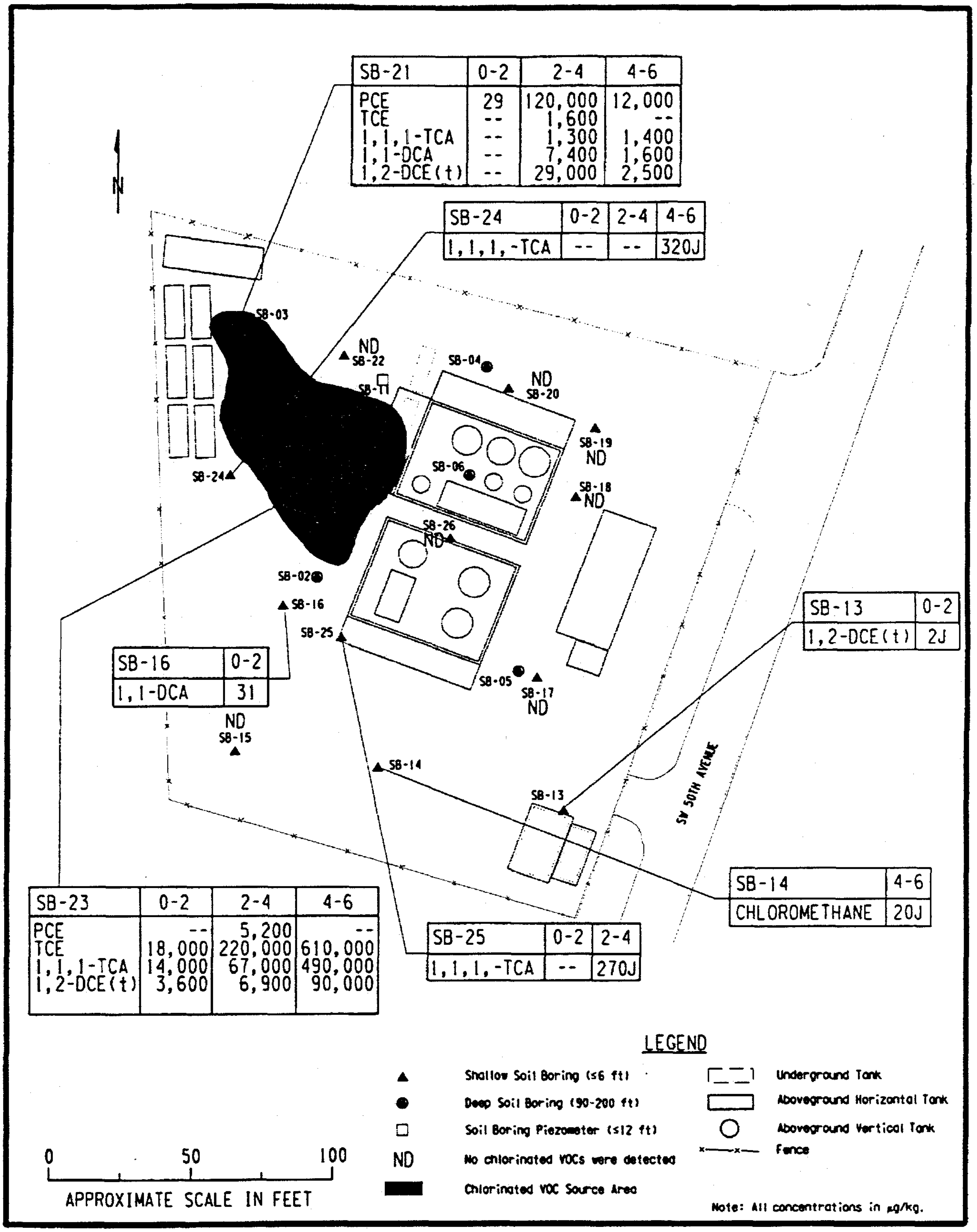


Figure 4-14
Chlorinated VOC Source Area
Florida Petroleum Reprocessors, Davie, Florida



SB-21	0-2	2-4	4-6
PCE	29	120,000	12,000
TCE	--	1,600	--
1,1,1-TCA	--	1,300	1,400
1,1-DCA	--	7,400	1,600
1,2-DCE(t)	--	29,000	2,500

SB-24	0-2	2-4	4-6
1,1,1,-TCA	--	--	320J

SB-13	0-2
1,2-DCE(t)	2J

SB-16	0-2
1,1-DCA	31

SB-14	4-6
CHLOROMETHANE	20J

SB-23	0-2	2-4	4-6
PCE	--	5,200	--
TCE	18,000	220,000	610,000
1,1,1-TCA	14,000	67,000	490,000
1,2-DCE(t)	3,600	6,900	90,000

SB-25	0-2	2-4
1,1,1,-TCA	--	270J

Figure 4-15
Chlorinated VOCs in Sitewide Soils
Florida Petroleum Reprocessors, Davie, Florida

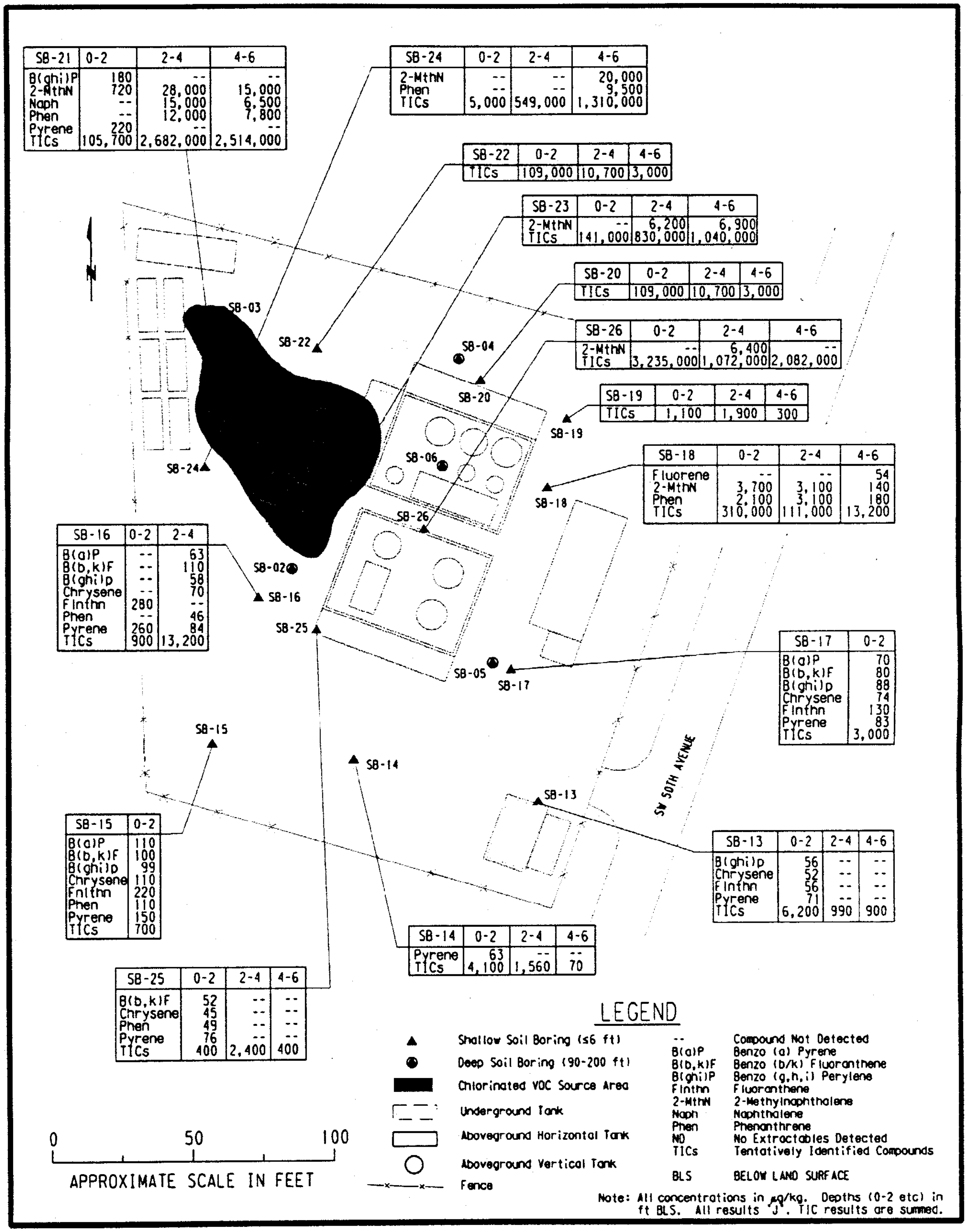


Figure 4-16
Extractable Organics in Sitewide Soils
Florida Petroleum Reprocessors, Davie, Florida

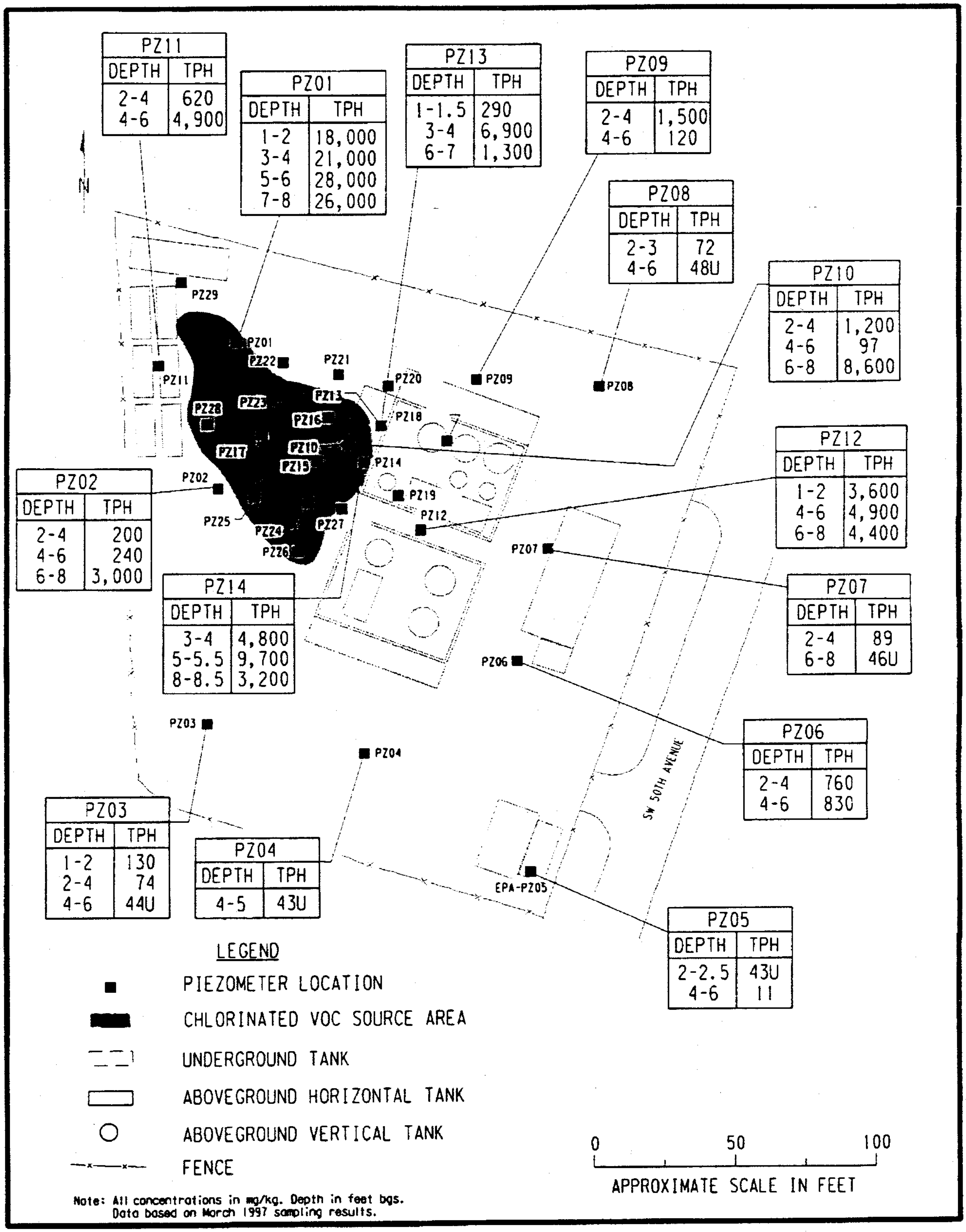


Figure 4-17
Total Petroleum Hydrocarbons in Sitewide Soils
Florida Petroleum Reprocessors, Davie, Florida

other areas of the Site, significant evidence of oil contamination (i.e., staining, odors, oily sheen) was nearly ubiquitous in soil samples collected from the Site, with the exception of samples collected from the Site's southern boundary.

Source Area Groundwater

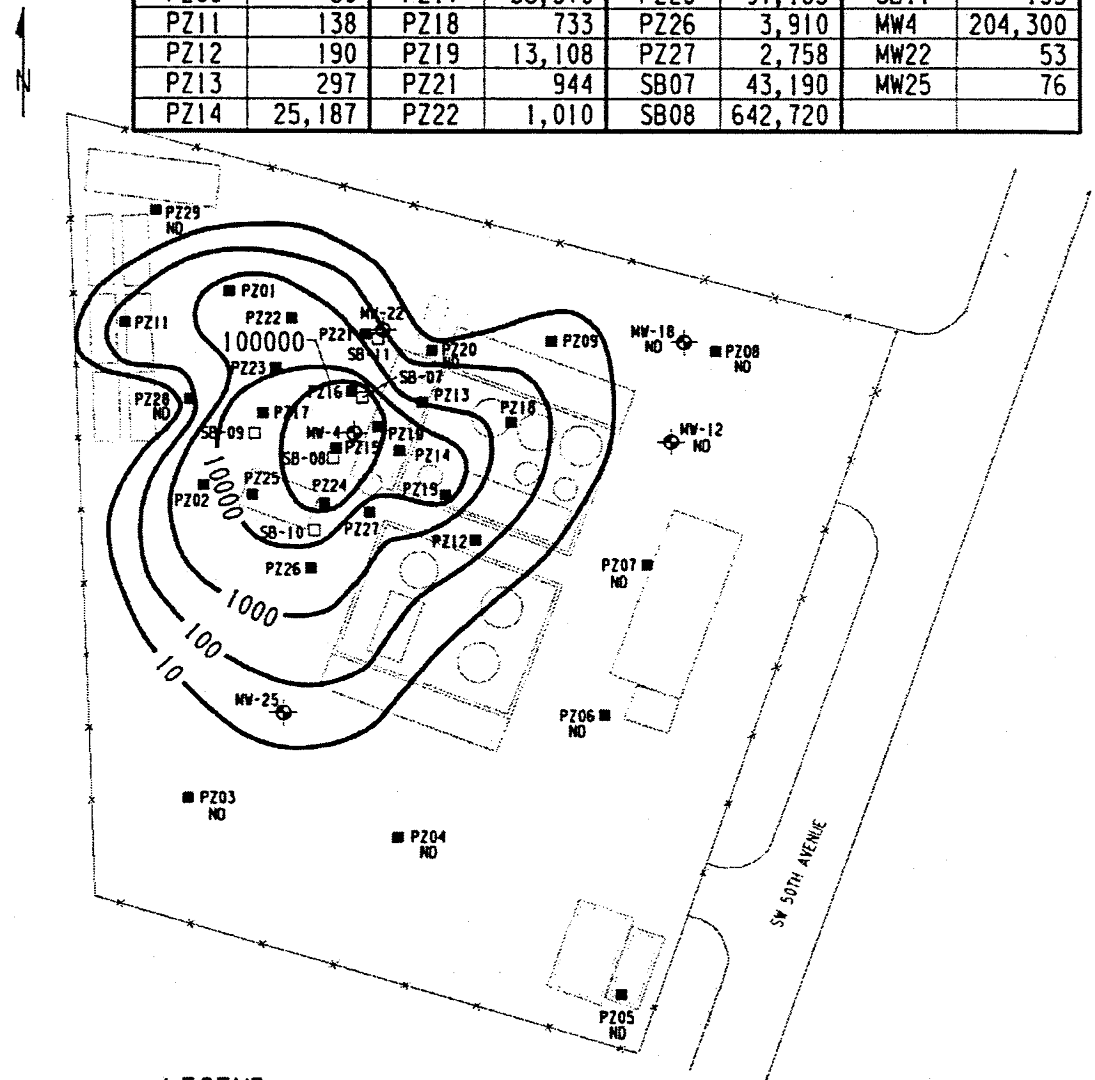
For the purposes of the FS, a TVOC concentration of 1,000 μg/L was selected as the basis for defining the source area groundwater. This definition was based on the assumption that groundwater containing 1,000 μg/L TVOCs represents a plume ("hot spot") capable of functioning as a potentially significant source of contamination for other less-contaminated groundwater. There are no recognized criteria for defining hot spots of contamination; in most cases, the label is applied to discrete areas having significantly higher levels of contamination than surrounding areas. Figure 4-18 shows the distribution of chlorinated TVOCs in groundwater samples from the FPR source area during the RI.

Groundwater samples collected from the source area contained unusually high levels of contamination. The principal contaminants include the waste solvents TCE and 1,1,1-TCA, and their degradation products 1,1-DCA, 1,1-DCE, 1,2-DCE, vinyl chloride, and chloroethane. In contrast to the source area soils, the groundwater samples contain a higher percentage of degradation products. In addition, vinyl chloride and/or chloroethane were present in most groundwater samples, but were noticeably absent from the source area soil samples. BTEX compounds were also detected in the groundwater, but at lower concentrations than in the soil samples. In the RI report, source area groundwater samples were organized into three categories based on sample collection depth: 4 to 12 feet bgs (water table); 20 to 45 feet; and greater than 45 feet. The following discussion is organized in a similar fashion.

The highest concentrations and most frequent detections of chlorinated VOCs were found in samples collected near the water table. The most significant observation from the water quality data is the magnitude of contamination. All sample locations had at least one individual chlorinated VOC exceeding 10,000 μg/L and several locations yielded samples with one or more chlorinated VOCs at concentrations exceeding 100,000 μg/L. Total chlorinated VOCs at these locations ranged from 45,970 to 642,600 μg/L.

The vertical and horizontal distribution of the plume of the source area groundwater contamination is shown in Figure 4-19. As evident from the data presented in this figure, there has been significant vertical migration of contaminants into the Biscayne aquifer. When compared to wells outside the source area, the data indicate that the deeper contamination has also migrated laterally through the more transmissive zones of the aquifer. TCE and 1,1,1-TCA comprise 40 to 60 percent of the total chlorinated VOCs in the deep source area groundwater. In wells beyond the source area, TCE was virtually absent, while 1,1,1-TCA typically comprised 20 percent of the contamination, suggesting that biodegradation is occurring in the deeper portions of the aquifer. However, the effectiveness of the complete biodegradation of the chlorinated VOCs is uncertain given the high levels of vinyl chloride remaining at the Site.

TOTAL CHLORINATED VOCs ($\mu g/L$)							
PZ01	1,172	PZ15	491,000	PZ23	1,590	SB09	70,400
PZ02	3,884	PZ16	147,900	PZ24	249,700	SB10	50,360
PZ09	60	PZ17	58,370	PZ25	97,185	SB11	135
PZ11	138	PZ18	733	PZ26	3,910	MW4	204,300
PZ12	190	PZ19	13,108	PZ27	2,758	MW22	53
PZ13	297	PZ21	944	SB07	43,190	MW25	76
PZ14	25,187	PZ22	1,010	SB08	642,720		



LEGEND

MONITORING WELL LOCATION

SOIL BORING PIEZOMETER LOCATION

PIEZOMETER LOCATION

FENCE

ND NOT DETECTED

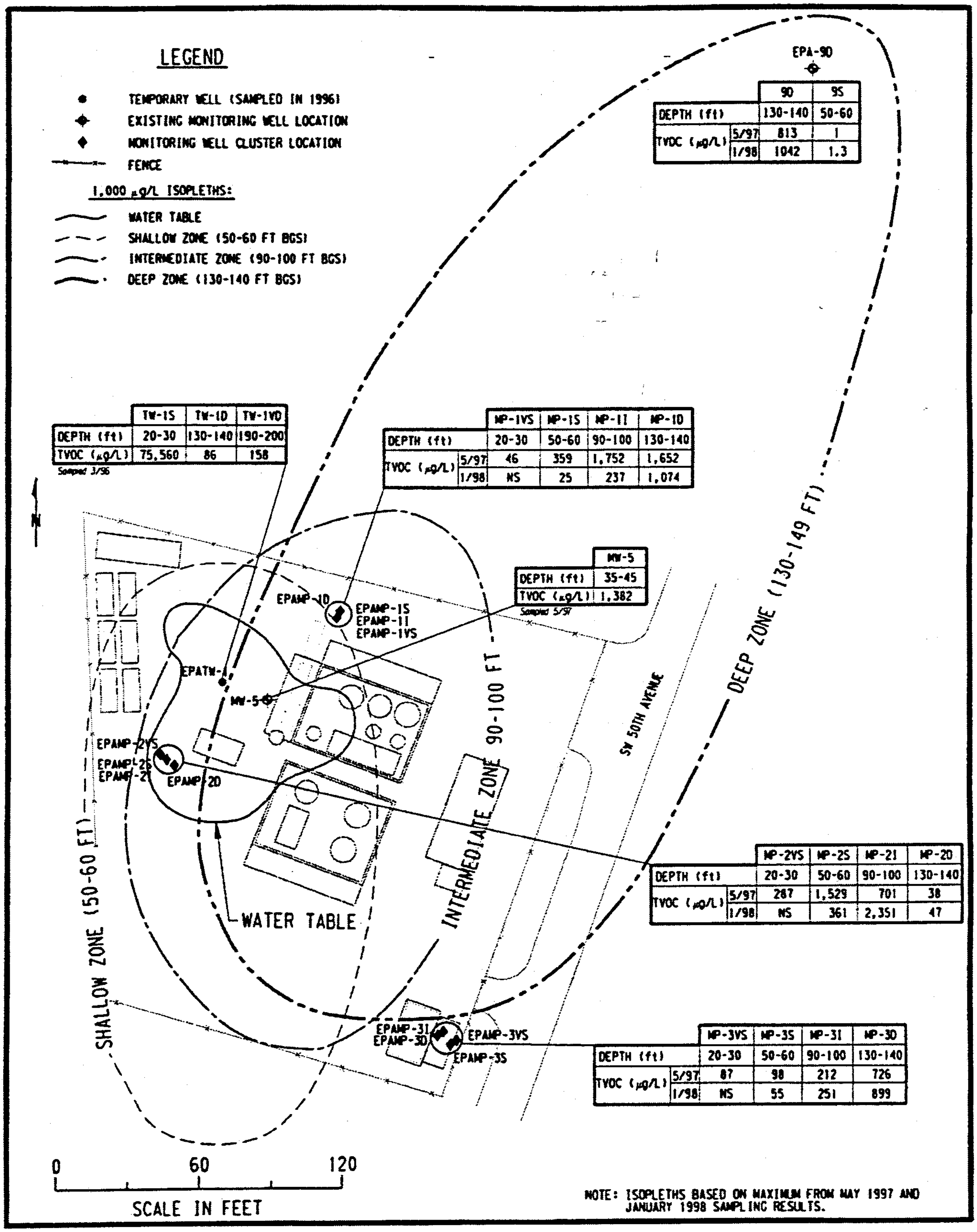
TVOC CONTOUR INTERVALS - 10,100,1000, 10000,100000 $\mu g/L$

0 50 100

APPROXIMATE SCALE IN FEET

Note: All concentrations based on March-May 1997 sampling results.

Figure 4-18
TVOC Plume at Water Table (April 1997)
Florida Petroleum Reprocessors, Davie, Florida



		9D	9S
DEPTH (ft)		130-140	50-60
TVOC (µg/L)	5/97	813	1
	1/98	1042	1.3

	TW-1S	TW-1D	TW-1VD
DEPTH (ft)	20-30	130-140	190-200
TVOC (µg/L)	75,560	86	158

		MP-1VS	MP-1S	MP-1I	MP-1D
DEPTH (ft)		20-30	50-60	90-100	130-140
TVOC (µg/L)	5/97	46	359	1,752	1,652
	1/98	NS	25	237	1,074

	MW-5
DEPTH (ft)	35-45
TVOC (µg/L)	1,382

		MP-2VS	MP-2S	MP-2I	MP-2D
DEPTH (ft)		20-30	50-60	90-100	130-140
TVOC (µg/L)	5/97	287	1,529	701	38
	1/98	NS	361	2,351	47

		MP-3VS	MP-3S	MP-3I	MP-3D
DEPTH (ft)		20-30	50-60	90-100	130-140
TVOC (µg/L)	5/97	87	98	212	726
	1/98	NS	55	251	899

Figure 4-19
TVOCs at Depth in Source Area Groundwater
Florida Petroleum Reprocessors, Davie, Florida

4.2.3 Aqueous Plume

In addition to the investigation of the nature and extent of contamination at the FPR facility, another objective of the RI was to investigate nearby areas believed to be impacted by releases from the FPR facility. For the purpose of this discussion the term "aqueous plume" will be used to define groundwater contamination related to releases from the FPR facility that are less than the 1,000 μg/L concentration used to define the groundwater source area.

This investigation included the sampling of groundwater monitoring wells generally located in an area between Peters Road to the north, U.S. Highway 441 to the east, Orange Drive to the south, and the Florida Turnpike to the west. Part of the rationale for investigating such a large area was based on the findings from earlier EPA studies of the Peele-Dixie Wellfield, which indicate that FPR was an apparent source of the wellfield contamination. In addition, investigation of this area provided for the evaluation of other potential sources of contamination of the Peele-Dixie Wellfield.

Evaluation of the aqueous plume of groundwater contamination was based on the results from analyses of samples collected during the RI from 80 monitoring wells and 1 production well. Table 4-3 presents a summary of information on the installation and construction details for these wells. Table 4-9 summarizes the results from analysis of groundwater samples used to evaluate the aqueous plume.

Results from analyses of samples collected in 1997 and 1998 from deep (130 to 140 feet bgs) groundwater monitoring wells document a plume approximately 13,000 feet long, extending from Peters Road to the north almost to Orange Drive to the south. The plume ranges in width from about 4,000 feet south of Oaks Road to about 1,300 feet in the wellfield. The extent of the deep zone of groundwater contamination documented in the RI is shown in Figure 4-20. It should be noted, however, that the full extent of the plume to the southeast, south, and southwest was not documented in the RI. The downgradient extent of the plume is estimated in Figure 4-20. Determination of the downgradient extent of contamination will be established during the remedial design process.

Results from the analyses of samples collected north of the FPR facility confirmed earlier sampling results, indicating widespread contamination in the area between the FPR facility and the Peele-Dixie Wellfield. In contrast to the groundwater at the FPR facility, the composition of the contaminants was primarily degradation products of TCE and 1,1,1-TCA, including 1,1-DCA, 1,2-DCA, 1,1-DCE, and vinyl chloride. A comparison of results from historical groundwater monitoring in the wellfield shows that there has been a steady decline in contaminant levels in the wellfield. Maximum concentrations of chlorinated VOCs declined from several hundred parts per billion in the late 1980s to the low ten of parts per billion in 1997. This significant reduction in contaminant levels is attributable to the interim pumping and treating of groundwater from wells in PW-17 and PW-18 beginning in 1994, and the lack of contributing sources of contamination within the current wellfield pumping influence.

Table 4-9
Chlorinated VOCs in Off-Site Monitoring Wells (1997 and 1998)
Florida Petroleum Reprocessors, Davie, Florida

(Page 1 of 2)

Station	Depth	Date	TCE	1,1-DCA	1,2-DCE	1,1-DCE	Vinyl Chloride	Chloro-ethane	TVOC
EPA-1S	50-60 ft	4/97	--	27	160	30	56	--	273
EPA-1D	130-140 ft	4/97	--	12	84	15	16	--	127
EPA-2S	51-61 ft	4/97	--	2	14	2	--	--	18
EPA-2D	130.8-140.8 ft	4/97	--	--	--	--	--	--	--
EPA-3D	132-142 ft	4/97	--	22	61	10	72	--	165
EPA-4S	51-61 ft	4/97	--	25	68	13	90	10	206
EPA-4D	130.8-140.8 ft	4/97	--	--	--	--	--	--	--
EPA-5S	50.8-60.8 ft	4/97	--	--	--	--	--	--	--
EPA-5D	131-141 ft	4/97	--	3	14	2	5	--	24
EPA-6S	50.8-60.8 ft	4/97	--	--	--	--	--	--	--
EPA-6D	131-141 ft	4/97	--	20	29	5	32	--	86
EPA-7D	130-140 ft	4/97	2	74	78	14	330	--	498
		1/98	--	55	46	9.2	350	--	460
EPA-8VS	9.5-10.5 ft	4/97	--	--	--	--	--	--	--
EPA-8S	50-60 ft	4/97	--	34	19	6	25	--	84
EPA-8D	129.5-139.5 ft	4/97	3	83	140	30	27	--	283
EPA-9S	50-60 ft	4/97	--	--	1	--	--	--	1
		1/98	--	--	--	--	1.3	--	1
EPA-9D	129-139 ft	4/97	6	33	560	94	120	--	813
		1/98	5.8	26	670	140	200	--	1042
EPA-10S	50-60 ft	4/97	3	39	150	26	130	--	348
EPA-10D	130-140 ft	4/97	1	10	51	9	7	--	78
EPA-11D	129.6-139.6 ft	4/97	--	10	52	8	25	--	95
EPA-12S	50.5-60.5 ft	4/97	--	1	7	2	--	--	10
EPA-14S	50-60 ft	4/97	--	39	2	--	28	--	69
		1/98	--	13	1.4	--	17	6.6	38
EPA-14D	130-140 ft	4/97	--	24	18	7	42	--	91
		1/98	--	17	42	9	110	--	178

Table 4-9
Chlorinated VOCs in Off-Site Monitoring Wells (1997 and 1998)
Florida Petroleum Reprocessors, Davie, Florida

Station	Depth	Date	TCE	1,1-DCA	1,2-DCE	1,1-DCE	Vinyl Chloride	Chloro-ethane	TVOC
EPA-15S	49-59 ft	4/97	--	--	4	--	--	--	7
		1/98	--	--	2.8	--	--	--	2.8
EPA-15D	128-138 ft	4/97	--	14	48	8	47	--	117
		1/98	1.4	31	81	16	150	--	279
EPA-16S	50-60 ft	4/97	--	--	--	--	--	--	--
		1/98	--	--	--	--	0.54	--	0.5
EPA-16D	129-139 ft	4/97	--	--	--	--	--	--	--
		1/98	--	--	--	--	--	--	--
EPA-17S	50-60 ft	4/97	--	--	--	--	--	--	--
		1/98	--	--	0.69	--	1.8	--	2.5
EPA-17D	132-142 ft	4/97	--	55	28	5	300	--	388
		1/98	--	51	26	5.6	350	--	433
EPA-18S	47-57 ft	4/97	--	--	--	--	--	--	--
		1/98	--	--	--	--	--	--	--
EPA-18D	130-140 ft	4/97	--	10	17	3	32	--	62
		1/98	0.57	8.2	19	3.3	36	--	67
EPA-19D	130-140 ft	1/98	0.71	25	34	6.3	110	--	176
EPA-20D	125.5-135.5 ft	1/98	--	10	14	2.7	49	--	76
EPA-21S	50-60 ft	1/98	--	--	--	--	--	--	--
EPA-21D	130-140 ft	1/98	--	22	26	6	250	--	304
EPA-22D	129.5-139.5 ft	1/98	--	74	110	21	490	--	695
DW2D	130-140 ft	4/97	--	--	7	--	--	--	7
DW4D	130-140 ft	4/97	--	--	9	--	--	--	9
DW19D	130-140 ft	4/97	--	2	10	1	--	--	13

All concentrations in µg/L.
-- = Compound not detected.
DW wells shown above were the only wells of this group containing chlorinated VOCs.
Complete analytical results from the April 1997 and January 1998 sampling events are presented in Appendix R of the 1998 RI by Bechtel.

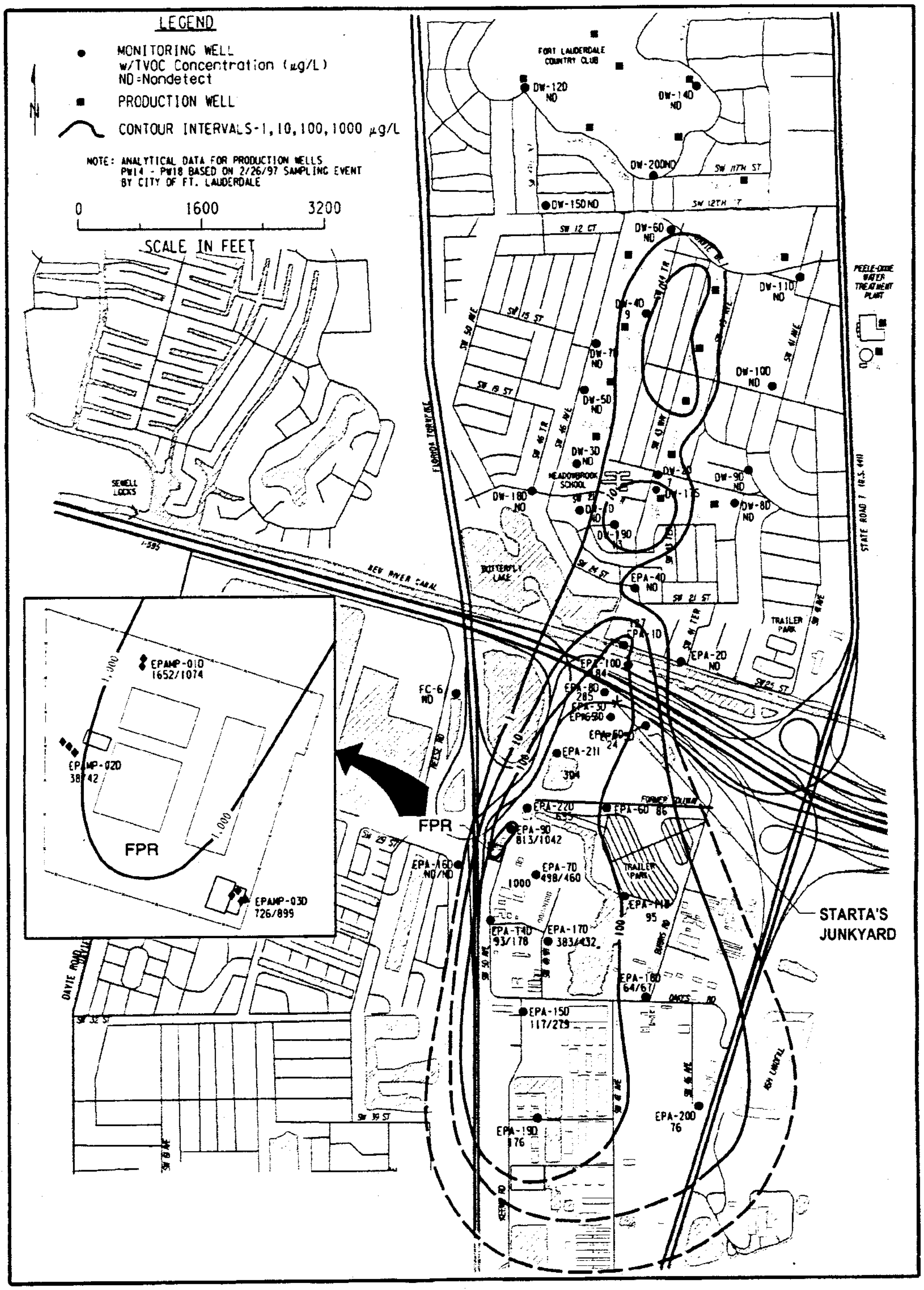


Figure 4-20
Total VOCs in Deep Zone Groundwater (1997 and 1998)
Florida Petroleum Reprocessors, Davie, Florida

Analytical results from wells south and east of the FPR facility indicate a plume of deep groundwater contamination similar to those detected at the facility and the Peele-Dixie Wellfield. The most commonly detected contaminants were 1,1-DCA, 1,2-DCE, and vinyl chloride. At the time of the RI in 1998, the highest concentration reported in this part of the plume was for vinyl chloride (330 μg/L in EPA-7D). Overall, vinyl chloride detected in the southeast area of the Site was much more prevalent and present in higher concentrations than those observed in samples from north of FPR. Resampling of the plume in January 2000 indicated that the levels of vinyl chloride had decreased (260 μg/L in EPA-7D).

In contrast to the decrease in contaminant levels in the Peele-Dixie Wellfield, there has not been a distinguishable trend of decreasing contaminant levels south of the FPR facility. This is attributable to an active source of contamination at the FPR facility. If the FPR source area were no longer active, contaminant levels would have been expected to decrease similar to those observed in the Peele-Dixie Wellfield. Continuing releases of contaminants from the FPR facility would explain the widespread distribution of relatively high levels of contamination (e.g., 432 μg/L TVOCs in well EPA-17D located more than 1,400 feet south of the FPR facility and 176 μg/L TVOCs in EPA-19 located more than 3,600 feet south of the facility). Nevertheless, it is anticipated that the source area will be addressed by a second soil removal action currently underway and a groundwater removal planned for fall of 2000.

A review of the results from analyses of groundwater samples collected from the shallow (i.e., 50 to 60 feet bgs) zone of the aquifer reveal two separate, much less extensive plumes of groundwater contamination. The extent of the shallow groundwater contaminant plumes is shown on Figure 4-21. The RI discusses in detail the reason for this significant difference in the pattern of contamination from the deeper zone of contamination. The two plumes are believed to be an indication of two separate sources of groundwater contamination. The shallow plume at the FPR facility indicates that there has been minor lateral dispersion of contamination from the facility in comparison to the lateral spread of contamination in the deeper portion of the aquifer. This difference is attributable not only to a downward vertical gradient, but also to significantly higher horizontal flow zones in the lower portion of the aquifer.

The second plume of shallow groundwater contamination is believed to be related to a source of groundwater contamination located along the former State Route 84 corridor. This area has since been covered by the expansion of I-595 and related exit/entrance ramps. A review of historical aerial photographs and state records indicates an automotive junkyard known as Starta's

Junkyard, and later known as Motor City Auto Parts, operated at this location from 1965 until 1984. A comparison of the groundwater data collected from shallow and deep well clusters located in the vicinity of the I-595 shallow plume indicates that this contamination has migrated downward, co-mingling with the deep plume of groundwater contamination from the FPR facility. Thus, any action to address the FPR-related plume will also address the groundwater contamination for the Starta's Junkyard.

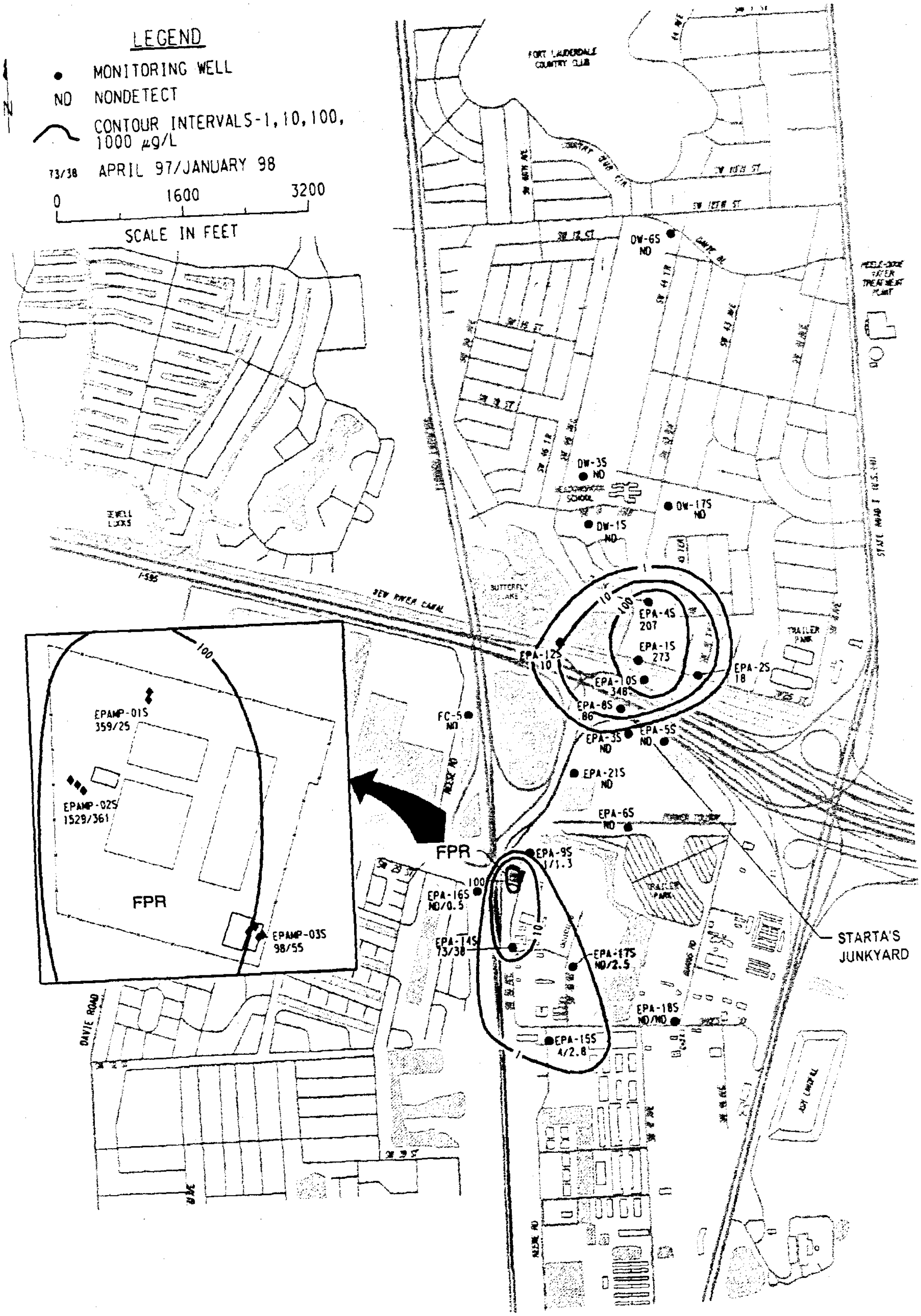


Figure 4-21
Chlorinated VOCs in Shallow Zone Groundwater (1997 and 1998)
Florida Petroleum Reprocessors, Davie, Florida

In an effort to reassess the current extent of groundwater contamination and to aid in the evaluation of potential groundwater removal actions, Golder Associates collected groundwater samples from monitoring wells throughout the aqueous plume in January 2000. The groundwater results showed a general decrease in groundwater contaminant levels at the facility and areas northward of the facility. Groundwater contaminant levels generally increased in wells south of the FPR facility, indicating a southward migration of the plume. A summary of the groundwater data is provided in Table 4-10. The extent of the shallow and deep groundwater plumes is shown in Figures 4-22 and 4-23.

4.2.4 Other Groundwater Sources Investigated

In addition to the characterization of the nature and extent of contamination associated with the FPR facility and its impact on the Peele-Dixie Wellfield, the RI investigated other sources of potential contamination to the wellfield, including a former dump, a residential area, two resource recovery facilities, four other waste oil facilities, and a residential area. This investigation included the review of state and local file information and, in some cases, the collection of additional data. Figure 4-7 shows the location of additional sources considered. While it appears that there are other sources of groundwater contamination to the Biscayne aquifer, they are very shallow, and negligible in size in comparison to contamination at the FPR facility. The results of the investigation of other areas of potential contamination are discussed in the following text.

Broward County 21st Manor Dump

The 21st Manor Dump is a former borrow pit that was used by the Broward County School Board from the 1950s to 1960s to dispose of trash and debris. The former Dump is located approximately 500 feet west of PW-18, and has since been filled in, and partially covered with the construction of 21st Manor and the adjacent Meadow Brook Elementary School. Extensive studies were conducted to assess the nature and extent of contamination and the relationship of the dump to the wellfield contamination. As part of the investigation, 25 boreholes were installed, along with the collection of over 50 subsurface soil and 13 groundwater samples, to determine if the dump represented a significant source of chlorinated VOCs that could be contributing to the contamination detected in the Peele-Dixie Wellfield. Of all the samples collected from within the waste material, none contained any detectable levels of chlorinated VOCs. Surface soil samples collected near the 21st Manor Dump did indicate the presence of toluene. A detailed summary of results of the investigation of the dump may be reviewed in the following reports by NUS: the site screening inspection (1988), special soils study (1989), and listing site inspection (1990).

Residential Sources

As part of the early RI investigations of the Peele-Dixie Wellfield, numerous residents in the vicinity of the wellfield were interviewed to determine if any automotive repair activities may have been conducted at a residence located in the wellfield. It was theorized that the spent solvents used to degrease automobile parts could have been discharged on the ground, in a septic

Table 4-10
Summary of VOCs in Groundwater (January 2000)
Florida Petroleum Reprocessors, Davie, Florida

(Page 1 of 2)

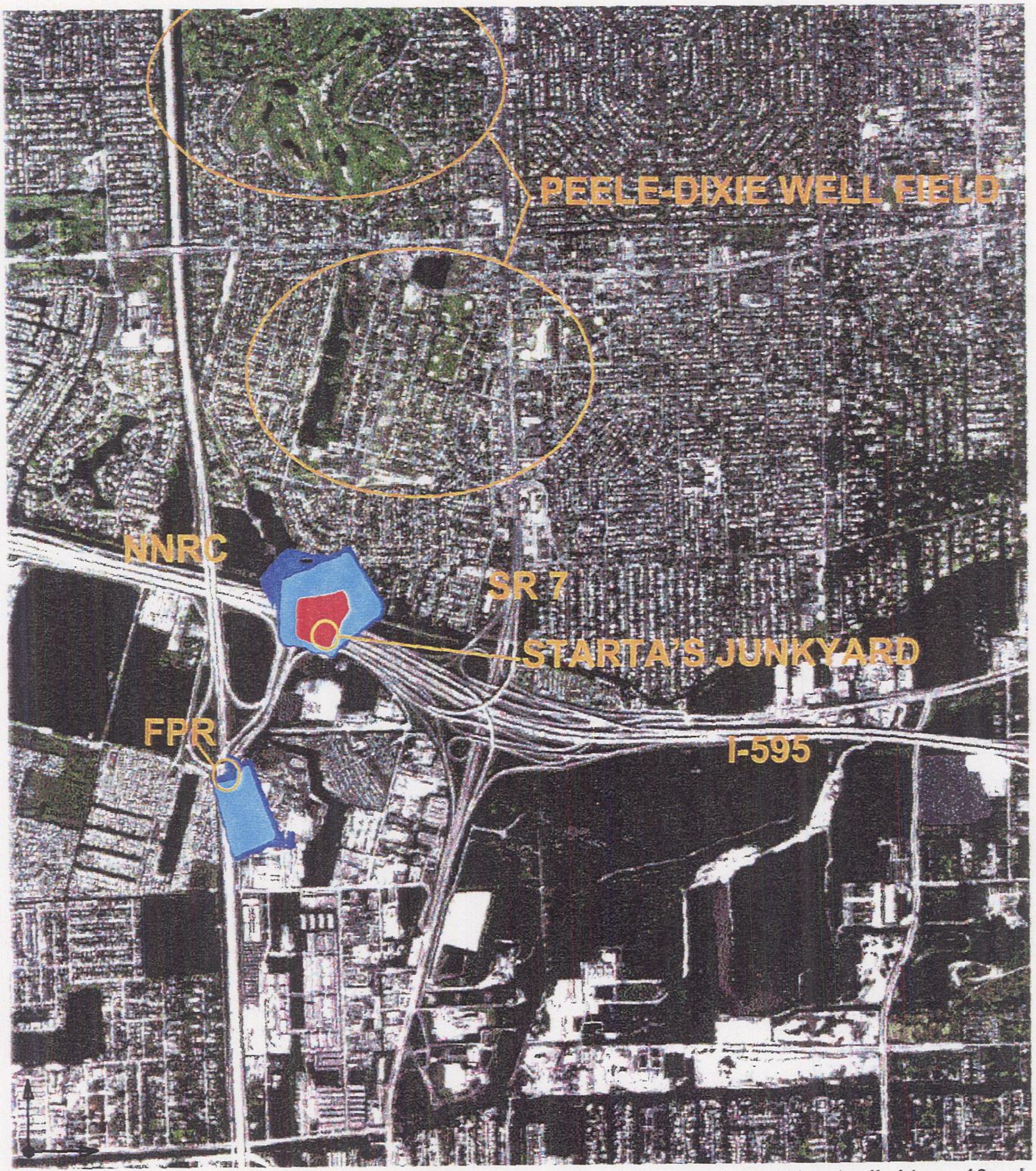
Monitoring Well ID	Screened Interval (ft bls)	Concentration (µg/L)											
		Benzene	Chloroethane	1,1-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Toluene	Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	Vinyl chloride	VOC Summation
Off-Site Wells													
EPA-1S	50-60	nd	5.4	nd	9.8	56	nd	nd	nd	nd	nd	59	130
EPA-1D	130.2-140.5	nd	nd	nd	6.2	37	nd	nd	nd	nd	nd	6.5	50
EPA-2S	50.8-60.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-2D	130.8-140.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-3D	131.8-141.8	nd	nd	nd	nd	7.2	nd	nd	nd	nd	nd	4.8	12
EPA-4S	50.8-60.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-4D	130.8-140.8	nd	nd	nd	nd	25	nd	nd	nd	nd	nd	2.4	27
EPA-5S	50.8-60.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-5D	130.8-140.8	nd	nd	nd	nd	6.0	nd	nd	nd	nd	nd	1.4	7
EPA-6S	50.8-60.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-6D	130.8-140.8	nd	nd	8.0	6.3	35	nd	nd	nd	nd	nd	40	89
EPA-7D	130-140	nd	nd	44	6.2	28	nd	nd	nd	nd	nd	260	338
EPA-8VS	9.5-19.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-8S	50-60	nd	nd	32	nd	64	nd	nd	nd	nd	nd	210	306
EPA-8D	129.5-139.5	nd	nd	nd	nd	250	nd	nd	nd	nd	nd	150	400
EPA-9S	50-60	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-9D	129-139	nd	nd	nd	80	370	nd	nd	110	nd	nd	160	720
EPA-10S	50-60	nd	nd	13	5.4	35	nd	nd	nd	nd	nd	77	130
EPA-10D	130-140	nd	nd	nd	6.7	43	nd	nd	nd	nd	nd	10	60
EPA-11D	129.6-139.6	nd	nd	17	13	79	nd	nd	nd	nd	nd	49	158
EPA-12S	50.5-60.5	nd	nd	nd	nd	5.2	nd	nd	nd	nd	nd	nd	5
EPA-14S	50-60	nd	9.9	25	nd	11	nd	nd	nd	nd	nd	56	102
EPA-14D	130-140	nd	nd	20	nd	38	nd	nd	nd	nd	nd	120	178
EPA-15S	49-59	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-15D	128-138	nd	nd	40	15	74	nd	nd	nd	nd	nd	200	329
EPA-16S	50-60	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-16D	129-139	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-17S	50-60	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	1.2	1
EPA-17D	132-142	nd	nd	50	6.5	36	nd	nd	nd	nd	nd	280	373
EPA-18S	47-57	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0

Table 4-10
Summary of VOCs in Groundwater (January 2000)
Florida Petroleum Reprocessors, Davie, Florida

(Page 2 of 2)

Monitoring Well ID	Screened Interval (ft bls)	Concentration (µg/L)											
		Benzene	Chloroethane	1,1-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Toluene	Tetrachloroethene	Trichloroethene	1,1,1-Trichloroethane	Vinyl chloride	VOC Summation
EPA-18D	130-140	nd	nd	9.9	nd	22	nd	nd	nd	nd	nd	38	70
EPA-19D	130-140	nd	nd	39	nd	41	nd	nd	nd	nd	nd	200	280
EPA-20D	125.5-135.5	nd	nd	11	nd	19	nd	nd	nd	nd	nd	52	82
EPA-21S	50-60	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
EPA-21D	130-140	nd	nd	nd	nd	27	nd	nd	nd	nd	nd	110	137
EPA-22D	129.5-139.5	nd	nd	71	nd	64	nd	nd	nd	nd	nd	400	535
On-Site Wells													
EPAMP-1VS	20-30	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	2.8	3
EPAMP-1S	49-59	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	3.4	3
EPAMP-1I	90.5-100.5	nd	nd	13	nd	8.3	nd	nd	nd	nd	11	13	45
EPAMP-1D	130-140	nd	nd	5.9	27	120	nd	nd	nd	nd	nd	88	241
EPAMP-2VS	20-30	nd	10	20	nd	nd	nd	nd	nd	nd	nd	2.0	32
EPAMP-2S	50-60	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	1.7	2
EPAMP-2I	90-100	nd	nd	31	nd	nd	nd	nd	nd	nd	14	15	60
EPAMP-2D	129.5-139.5	nd	nd	nd	nd	8.2	nd	nd	nd	nd	nd	8.8	17
EPAMP-3VS	19.5-29.5	nd	18	20	nd	nd	nd	nd	nd	nd	nd	14	52
EPAMP-3S	49.5-59.5	nd	nd	14	nd	8.8	nd	nd	nd	nd	15	17	55
EPAMP-3I	89-99	nd	nd	41	6.0	7.6	nd	nd	nd	5.7	nd	68	128
EPAMP-3D	129-139	nd	nd	nd	27	130	nd	nd	nd	nd	nd	90	247
FPR-1	20-30	nd	30	160	nd	nd	nd	nd	nd	nd	57	9.6	257
SMW-1	2.5-12.5	nd	6.9	41	nd	5.7	nd	8.3	nd	nd	nd	31	93
SMW-2	2.5-12.5	nd	nd	170	nd	nd	nd	nd	nd	nd	nd	340	510
SMW-3	2.5-12.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
SMW-4	2.5-12.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	1.2	1
SMW-5	2.5-12.5	nd	320	820	nd	2000	nd	nd	nd	71	1300	1500	6011
MW-18	3.0-13	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0
MW-22	3.0-13	nd	nd	42	nd	21	nd	nd	nd	7.8	17	6.6	94
MW-5	35-45	2.0	78	46	nd	14	7.2	14	nd	nd	13	17	191

Notes:
nd = Not detected.



LEGEND: Red > 100 ppb; lt. blue 10 to 100 ppb; dk. blue < 10 ppb

Figure 4-22
Shallow VOC Plume
Florida Petroleum Reprocessors, Davie, Florida

LEGEND: Red > 100 ppb; lt. blue 10 to 100 ppb; dk. blue <10 ppb

Figure 4-23
Deep VOC Plume (January 2000)
Florida Petroleum Reprocessors, Davie, Florida

tank, or into a storm drain. From the survey, it was reported that discharges of wastes from automotive repairs to a nearby storm drain may have occurred from the residence located at the southwest corner of 43rd Terrace and SW 22nd Court. The drain was sampled, however, and was found to contain no detectable levels of chlorinated VOCs. The results from this effort is discussed in detail in the 1994 Peele-Dixie Wellfield preliminary site characterization report by Bechtel.

National Resource Recovery (a.k.a. Atlas Waste Magic/Atlas Metals)

National Resource Recovery is located at 3250 SW 50th Avenue, Davie, Florida, (immediately east of the FPR facility) and is currently occupied by Atlas Waste Magic, a recycling and construction/demolition disposal debris facility. Approximately 20 acres of the property are used for recycling and the remaining 11 acres consist of a lake that is being filled with construction debris. Mounds of wood and vegetative compost from the operations have been deposited to the north of the facility. The Atlas Metals site has a long history of compliance problems with the FDEP and the Broward County Department of Natural Resources Protection, primarily associated with the management of the facility and odors associated with the composting operations. Independent of the FPR RI, EPA conducted a site investigation in June 1996 and found no significant levels of chlorinated VOCs in any of the soil and groundwater sampled. Contaminants detected primarily included metals, extractable organic compounds, and pesticides. Results from the investigation may be found in the 1997 Atlas Metals site investigation report by Black & Veatch Special Projects Corporation.

Wheelabrator South Broward, Inc.

In the late 1980s, Broward County contracted with subsidiaries of Wheelabrator Environmental Systems, Inc. to design, construct, and operate two waste-to-energy plants to provide an environmentally safe and cost-effective solid waste disposal solution; recover energy and recyclable ferrous metals; and reduce the quantity of waste subject to landfilling. The south plant opened in 1991 and is located at 4400 South State Road 7, 1.4 miles southeast of the FPR facility. As part of the FPR RI, several wells that are part of the plant's groundwater monitoring network were sampled, and no significant levels of chlorinated solvents were detected.

Perma-Fix Environmental Services, Inc.

Perma-Fix is located at 3701 SW 47th Avenue, approximately 0.4 miles southeast of the FPR facility. The Perma-Fix facility receives, filters, separates, blends, and temporarily stores used oils for subsequent resale, primarily as fuel. The facility also has the capability for the treatment of oil contaminated wastewater.

As part of the FPR RI, samples were collected from eight water table wells at the facility. Results from analyses indicated negligible contamination from chlorinated VOCs in comparison to contamination detected at the FPR facility. TCE, 1,2-DCE, and vinyl chloride were detected in samples collected from the facility in 1998 at concentrations ranging from 1 to 20 $\mu g/L$. Annual groundwater monitoring results from 1997 only indicated the presence of vinyl chloride at concentrations ranging from 2 to 177 $\mu g/L$. Table 4-11 includes a comparison of the MCLs detected at the FPR facility and Perma-Fix (and the other waste oil facilities investigated).

At the time of the collection of the groundwater samples in 1998, operations at the Perma-Fix facility appeared to be relatively clean. Prior to the sampling, however, a spill occurred at the facility in October 1996 as a result of vandalism. The spill was quickly recovered, as is apparent from the subsequent groundwater monitoring, which did not disclose any significant groundwater contamination by chlorinated VOCs.

Petroleum Management, Inc.

The offices for PMI are located at 4700 Oaks Road, and the facility is located on SW 47th Avenue, adjacent to the southern property boundary of Perma-Fix. The PMI facility also handles used oil and reportedly conducts or supports a variety of environmental cleanup activities, such as the removal of underground tanks and contaminated soils. During the FPR field investigation, an attempt was made to sample PMI groundwater monitoring wells. However, these wells were not functioning properly and could not be sampled. Discussions with Broward County indicated that this facility is currently regulated under the county's waste oil program and they do not believe that PMI is a significant source of chlorinated VOC contamination. That assessment is consistent with the lack of significant groundwater contamination detected in shallow monitoring wells installed in the vicinity of the PMI facility during the FPR RI.

Neff Oil & Cramer-Maurer Oil Pit

Neff Oil and Cramer-Maurer Oil Pit are two former waste oil facilities located at 3830 and 3820 SW 47th Avenue, Davie, Florida, respectively. Available file information indicates that Neff Oil reportedly operated a short term, small quantity waste oil storage facility during the 1970s and 1980s. Immediately south of Neff Oil was Cramer-Maurer Oil Pit. Cramer-Maurer Oil Pit was constructed in 1975 for the storage of waste oil and tank bottoms, but was also reportedly used for the discharge of waste materials from Neff Oil. This pit was the former location of a plastic-lined aboveground waste oil pit approximately 110 feet square and 5 feet deep. The Neff Oil operations were conducted on property leased from Joey Danielle, while the oil pit was located partially on property owner by Cramer-Maurer and Madeline Woo and Associates.

Based on available file information, Neff Oil and Cramer-Maurer Oil Pit appear to have been closed under FDER and Broward County Environmental Quality Control Board oversight in the mid-1980s and 1993, respectively. While both facilities contained extensive petroleum-related contamination associated with waste oils, analyses of soil and groundwater samples collected from these facilities did not contain significant levels of chlorinated VOCs. The highest level of chlorinated VOCs reported from either facility was 55 $\mu g/kg$ of PCE detected in a soil sample collected during an EPA site investigation in 1987. As a result of the minimal chlorinated VOC contamination, neither facility is considered to be a contributor of the chlorinated VOC groundwater contamination detected during the FPR RI.

Table 4-11
Selected Maximum Chlorinated VOCs & Other Nearby Oil Facilities
Florida Petroleum Reprocessors, Davie, Florida

Contaminant	Fla. Petroleum Reprocesors	Perma-Fix, Inc.	Cramer Maurer Oil	Neff Oil	Petroleum Mgt., Inc.
PCE	260	ND/ND	ND	ND	NA
TCE	100,000	1/ND	ND	ND	NA
1,2-DCE	270,000	5/ND	3	1	NA
Vinyl Chloride	18,000	20/177	ND	43	NA

Notes:
1 - First value is EPA data collected in January 1998 and part of the RI by Bechtel. Second value is from Perma-Fix sampling of facility in March 1997.

5.0 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

The FPR Site, including the FPR facility and aqueous plume, encompasses a large area that includes a mixture of industrial, commercial, and residential land uses. Much of this land has already been developed.

Contamination from the Site and the Site remedy itself are expected to have little effect on the current or potential future surface uses of surrounding land. Once the ongoing removal action is complete in the spring of 2001, the FPR facility should be available for reuse of the landsurface. Activities could not affect the underlying groundwater.

The main effect from this Site is on current and future drinking water resources. Releases of contaminants from this facility have severely impacted the Biscayne aquifer, a sole source of drinking water for Dade and Broward counties. Locally, the Site has impacted the Peele-Dixie Wellfield, thus impairing the City of Fort Lauderdale's ability to operate its water supply system in an efficient manner. While the City has been able to continue to maintain a safe drinking water supply and serve its current water demand, future changes in population growth and competition with agriculture, industry, and the environment for limited water uses could impair the City of Fort Lauderdale's ability to meet its future water supply demands.

6.0 SUMMARY OF SITE RISKS

As part of the RI, EPA conducted a baseline risk assessment (BRA) for the FPR Site to evaluate the probability and magnitude of potential adverse effects on human health and the environment associated with actual or potential exposure to site-related chemicals. The human health risk assessment (HHRA) and the ecological risk assessment (ERA) are discussed in the following sections.

As outlined in the text, the primary driver for the BRA was the potential for future exposures to contaminated groundwater. No significant human health or ecological risk as a result of exposure to contaminated soil was documented. In addition to the potential risk to human health from future groundwater exposures, significant exceedances of drinking water regulatory standards and criteria for protection of groundwater from the leaching of contaminants from soil were documented as part of the RI. Because the significant exceedances of regulatory standards weighed heavily in the formulation of the basis for undertaking a response action at the FPR Site, only a brief summary of the results from the risk assessment is provided in the ROD. For a detailed discussion of the scope, health criteria, and results of the BRA, the final RI report should be consulted.

Human Health Risk Assessment

The HHRA was performed to evaluate the potential human health effects associated with chemical contamination from past operations at the FPR Site. For the purposes of the HHRA, groundwater analytical results were evaluated in three data groupings (i.e., On-Site Wells; EPA, Perma-Fix, and Davie Concrete Wells; and Peele-Dixie Wellfield and Wheelabrator Wells). Surface soil, subsurface soil, surface water, and sediment were each grouped into "Sitewide" data groupings. Potential risks associated with exposures to surface water were not calculated in the HHRA since no chemicals of potential concern (COPC) were selected for this medium.

The HHRA was performed for both current and future land-use conditions. Under current land-use conditions, trespasser exposures to surface soil sediment via incidental ingestion, dermal absorption, and inhalation (surface soil only) were evaluated. Under future land-use conditions, excavation worker exposures to subsurface soil via incidental ingestion, dermal absorption, and inhalation were evaluated, and Site worker exposures to groundwater via ingestion and surface soil via incidental ingestion, dermal absorption, and inhalation were evaluated. In addition, adult and child resident exposures to both groundwater and surface soil via ingestion, dermal absorption, and inhalation (excluding inhalation of chemicals in groundwater by child residents) were evaluated. Child resident exposures to sediment via incidental ingestion and dermal absorption were also evaluated.

Upper-bound excess lifetime cancer risks and noncancer hazard indices (HIs) were estimated for each of the exposure pathways according to the data groupings previously described. These estimates were based on all COPCs selected for each data grouping, except for chemicals for which toxicity criteria were unavailable. A summary of upper-bound excess lifetime cancer risks and HIs for all exposure pathways evaluated in the HHRA, along with the predominant chemicals associated with each pathway, is presented in Table 6-1.

The risk characterization results showed unacceptable risks (i.e., upper-bound excess lifetime cancer risks exceeding the upper limit of EPA's target risk range for health protectiveness at Superfund sites [1×10^{-4}] and/or noncancer HIs greater than 1) for each of the groundwater data groupings evaluated in the HHRA. As described in the following text, the greatest cancer and noncancer risks were associated with the On-Site Wells and EPA, Perma-Fix, and Davie Concrete Wells data groupings.

In the On-Site Wells data grouping, all total cancer risks estimates based on Site worker, adult resident, and child resident exposures to groundwater were above the 1×10^{-4} risk level for all pathways. Noncancer HIs were significantly greater than 1 for all pathways and receptors, with the exception of inhalation by future adult residents. Cancer risks in the On-Site Wells data grouping were primarily associated with exposures to vinyl chloride and 1,1-DCE, while noncancer hazards were primarily associated with 1,2-DCE (total), cis-1,2-DCE, 1,1,1-TCA, and TCE.

In the EPA, Perma-Fix, and Davie Concrete Wells data grouping, total cancer risk estimates based on Site worker, adult resident, and child resident exposures to groundwater were above or at the high end of the target risk range for all pathways and receptors. Noncancer HIs were less than 1 for all pathways except the child resident groundwater ingestion pathway, for which the HI only slightly exceeded 1. Cancer risks in the EPA, Perma-Fix, and Davie Concrete Wells data grouping were primarily associated with exposures to vinyl chloride.

Table 6-1
Summary of Risks and Cumulative Risk Estimates
Florida Petroleum Reprocessors
Davie, Florida

(Page 1 of 2)

Receptor/Pathway	Cancer Risk	Predominant Chemicals[a]	Noncancer Hazard Index	Predominant Chemicals[a]
Future Land-Use Conditions				
Adult Resident				
Groundwater (On-Site Wells)				
Ingestion	5×10^{-2}	Benzene, 1,1-DCE, bis(2-ethylhexyl)phthalate, N-nitrosodi-n-propylamine, PCE, TCE, vinyl chloride	200	1,1-DCA, 1,1-DCE 1,2-DCE (total), cis-1,2-DCE, 1,1,1-TCA, TCE
Dermal	3×10^{-3}	1,1-DCE, bis-(2-ethylhexyl)phthalate, N-Nitroso-di-n-propylamine, PCE, TCE, vinyl chloride	20	1,2-DCE (total), cis-1,2-DCE, 1,1,1-TCA, TCE
Inhalation	6×10^{-3}	Benzene, chloroform, 1,1-DCE, TCE, vinyl chloride	1	[b]
Groundwater (EPA, Perma-Fix, and Davie Concrete Wells)				
Ingestion	1×10^{-3}	Benzene, bromodichloromethane, 1,1-DCE, 1,1,2,2-PCA, vinyl chloride	<1 (8×10^{-1})	--
Dermal	6×10^{-5}	1,1-DCE, vinyl chloride	<1 (3×10^{-2})	--
Inhalation	2×10^{-4}	Benzene, chloroform, 1,1-DCE, 1,1,2,2,-PCA, vinyl chloride	<1 (6×10^{-2})	--
Groundwater (DW and Wheelabrator Wells)				
Ingestion	8×10^{-6}	1,1-DCE	1	Iron
Dermal	7×10^{-7}	[b]	<1 (1×10^{-2})	--
Inhalation	2×10^{-6}	1,1-DCE	--	--
Surface Soil				
Incidental Ingestion	2×10^{-5}	Arsenic	<1 (4×10^{-2})	--
Dermal Contact	5×10^{-6}	Benzo(a)pyrene, arsenic	<1 (8×10^{-2})	--
Inhalation	2×10^{-5}	Arsenic	--	--
Cumulative Risk[c]	$\mathbf{6 \times 10^{-2}}$		**220**	

Table 6-1
Summary of Risks and Cumulative Risk Estimates
Florida Petroleum Reprocessors
Davie, Florida

(Page 2 of 2)

Receptor/Pathway	Cancer Risk	Predominant Chemicals[a]	Noncancer Hazard Index	Predominant Chemicals[a]
Future Land-Use Conditions				
Child Resident				
Groundwater (On-Site Wells)				
Ingestion	2×10^{-2}	Benzene, 1,1-DCE, N-nitroso-di-n-propylamine, PCE, TCE, vinyl chloride	500	1,1-DCA, 1,1-DCE 1,2-DCE (total), cis-1,2-DCE, 1,1-TCA, TCE, iron
Dermal	9×10^{-4}	1,1-DCE, bis(2-ethylhexyl)phthalate, N-nitroso-di-n-propylamine, PCE, TCE, vinyl chloride	40	1,2-DCE (total), cis-1,2-DCE, 1,1,1-TCA, TCE
Groundwater (DW and Wheelabrator Wells)				
Ingestion	4×10^{-6}	1,1-Dichloroethene	3	Iron
Dermal	3×10^{-7}	--	<1 (3×10^{-2})	--
Surface Soil				
Incidental Ingestion	4×10^{-6}	TCE, Arsenic	<1 (4×10^{-1})	--
Dermal Contact	2×10^{-6}	[b]	<1 (1×10^{-1})	--
Inhalation	3×10^{-6}	Arsenic	--	--
Sediment				
Incidental Ingestion	1×10^{-6}	Benzo(a)pyrene	<1 (5×10^{-4})	--
Dermal Contact	9×10^{-7}	--	<1 (2×10^{-4})	--
Cumulative Risk[c]	**2×10^{-2}**		**550**	

[a] For carcinogenic compounds, the predominant chemicals that had a chemical-specific cancer risk greater than or equal to 1×10^{-6}. For noncarcinogenic compounds, the predominant chemicals had a hazard quotient greater than or equal to 1 for a specific target organ.

[b] The cancer risk for each COPC was < 1×10^{-6} or the hazard quotient for each COPC was <1.

[c] Since it is unlikely that an individual at the FPR Site would be exposed to groundwater in all of the data groupings, only the on-site wells data grouping, which presents the greatest potential risk due to exposures to groundwater, was used to determine cumulative risks.

In the Peele-Dixie Wellfield and Wheelabrator Wells data grouping, all cancer risk estimates based on Site worker, adult resident, and child resident exposures to groundwater were less than or equal to 4 x10^{-6}, which is at the low end of EPA's target risk range for health protectiveness at Superfund sites. Noncancer HIs were less than or equal to 1 for all pathways except the child resident groundwater ingestion pathway, for which the HI slightly exceeded 1. Cancer risks in the Peele-Dixie Wellfield and Wheelabrator Wells data grouping were primarily associated with exposures to 1,1-DCE.

Total cancer risk estimates based on exposures to surface soil, subsurface soil, and sediment at the FPR Site were typically at the low end of or below EPA's target risk range, with the exception of the inhalation of COPCs in soil. The noncancer HIs associated with exposures to surface soil, subsurface soil, and sediment were all less than 1.

In summary, the BRA found that the only pathway of concern involved ingestion, inhalation, or dermal absorption of contaminated groundwater (on-site and off-site) by Site workers or residents under the future land-use scenarios. Based on this finding, contaminated groundwater represents the exposure pathway of concern for the FPR Site.

Ecological Risk Assessment

An ERA was performed as part of the BRA to evaluate potential ecological effects associated with chemical contamination from past operations at the FPR facility. The habitat quality at the Site has been degraded to the extent that few ecological receptors would inhabit or utilize the Site. Based on an analysis of the wildlife species potentially occurring at the FPR facility and the COPCs in the environmental media, the following endpoints were selected for evaluation in the ERA: adverse effects to aquatic life from exposure to chemicals in sediment; and adverse effects to aquatic life from exposure to chemicals in surface water. The following general conclusions were made regarding the Site's potential for adverse effects on ecological receptors.

Terrestrial wildlife are not expected to be at risk of experiencing adverse effects from any COPCs detected in surface soil at the FPR facility or COPCs detected in surface water and sediment in the nearby (off-site) wetlands associated with the Turnpike drainage system. The primary basis for this conclusion is that use of these areas, especially the FPR facility, by wildlife is expected to be minimal given the habitat limitations and the relatively small area. In addition, the industrial nature of the Site would preclude most terrestrial plants and soil invertebrates from inhabiting it.

The results of the sediment analysis indicate a potential for carbon disulfide, benzo(a)pyrene, chrysene, fluoranthene, pyrene, gamma-chlordane, arsenic, iron, and lead to adversely affect benthic life. Most of these chemicals exceeded the toxicity reference value (TRV) at two of the three sample locations in the Turnpike drainage wetlands. However, the conservative nature of the TRV suggests that the potential for adverse effects to benthic organisms has been overestimated. The sediment data also suggest that some of the COPCs detected at concentrations with the potential to adversely affect benthic organisms may have originated partially or wholly from sources other than the FPR Site (i.e., highway and past agricultural activities). Most of the COPCs with environmental effects quotients (EEQs) greater than or equal to one were detected at higher concentrations in the upgradient drainage ditch.

The results of the surface water analysis indicate that manganese is the only inorganic surface water COPC in the off-site wetlands that has the potential to adversely affect aquatic life. However, the magnitude of the EEQ also suggests that potential for adverse effects to aquatic life from manganese would be limited. Maximum concentrations of manganese were at or above the TRV in both the upgradient stream and the wetlands, suggesting sources of manganese other than or in addition to the FPR facility. No organic COPCs were detected in wetland surface water samples or in the North New River Canal. The absence of site-related contamination in the canal indicates that any discharge of contaminated groundwater from the FPR/Peele-Dixie Wellfield plume apparently has no impact on water quality in the canal.

7.0 REMEDIAL ACTION OBJECTIVES

A summary of the RAOs for this Site includes:

- Restore the aquifer by reducing contaminant levels to drinking water standards (i.e., federal and state MCLs) within a reasonable time frame.
- Contain or minimize the future migration of the plume.
- Maximize protection of the Peele-Dixie Wellfield as soon as possible such that the use of this public resource may resume at levels consistent with pre-1986 conditions.

These RAOs are established based on the fact that the contaminants that have migrated from this facility have impacted a large portion of the Biscayne aquifer. The Biscayne aquifer is a sole source drinking water supply for Dade and Broward counties. Due to its importance as a drinking water resource and its vulnerability to contamination, this aquifer has been federally classified as a "sole source aquifer." Releases primarily from the FPR facility and the I-595 secondary source area are believed to have impacted the Peele-Dixie Wellfield, a municipal drinking water supply north of the Site, in the past. This contamination has diminished the value and use of the sole source resource and, if not addressed, will continue to impair the City of Fort Lauderdale's municipal water system.

Attainment of these RAOs will reduce contaminant levels in the Biscayne aquifer to within MCLs in a reasonable period of time, thus providing unlimited use of this sole source aquifer. A secondary benefit is that the City of Fort Lauderdale will also be able to begin unrestricted reuse of the southern portion of the wellfield without the potential for further contamination of the wellfield from the FPR facility and I-595 secondary source area.

8.0 DESCRIPTION OF ALTERNATIVES

8.1 <u>Description of Remedy Components</u>

The following sections provide a brief summary of the remedies evaluated in the FSA report dated June 2000 and the major components of each of the remedies. As discussed in the FSA, these alternatives are intended to address threats solely posed by contaminated groundwater. Threats posed by contaminated soils have either been eliminated in 1999 or are being addressed through a removal action that is to be implemented in the fall of 2000.

8.1.1 No Action - Alternative GW1

- Natural Attenuation
- No Monitoring
- No Contingent Alternatives.

8.1.2 Monitored Natural Attenuation - Alternative GW2

- Natural attenuation of groundwater contaminants throughout the groundwater plume that exceed MCLs
- Reduced contaminant levels through natural intrinsic biological and chemical processes, as indicated by results from the RI
- Long-term groundwater monitoring to ensure attainment and long-term compliance with MCLs
- Long-term groundwater monitoring to ensure that the groundwater plume is degraded and does not pose a threat to other drinking water resources.

8.1.3 Source Remediation and Monitored Natural Attenuation - Alternative GW3

Source Remediation

- Groundwater recovery via extraction wells at FPR facility
- Limited groundwater recovery (i.e., 100 gallons per minute) designed to capture highly contaminated groundwater that represents an ongoing source of contaminants to the Biscayne aquifer
- On-site treatment of contaminated groundwater via air stripping
- On-site disposal of treated groundwater.

Monitored Natural Attenuation

- Natural attenuation of groundwater contaminants throughout the Site groundwater plume that exceed MCLs
- Reduced contaminant levels through natural intrinsic biological and chemical processes, as indicated by results from the RI
- Long-term groundwater monitoring to ensure attainment and long-term compliance with MCLs.
- Long-term groundwater monitoring to ensure that the groundwater plume is degraded and does not pose a threat to other drinking water resources.

8.1.4 Source Remediation, Wellfield Protection, and Monitored Natural Attenuation - Alternative GW4

Source Remediation

- Groundwater recovery via extraction wells at FPR facility.
- Limited groundwater recovery (i.e., 100 gallons per minute) designed to capture highly contaminated groundwater that represents an ongoing source of contaminants to the Biscayne aquifer
- On-site treatment of contaminated groundwater via air stripping
- On-site disposal of treated groundwater.

Wellfield Protection

- Plume containment using a hydraulic containment barrier or similar demonstrated technology to create and maintain separation between the Peele-Dixie Wellfield and the northern portion of the plume, which exceeds MCLs
- Extraction wells south of I-595 to obtain water for the creation of the hydraulic containment barrier
- Treatment, as necessary, for the reinjection of groundwater necessary to form the barrier
- Injection wells north of I-595 to create the hydraulic containment barrier
- Long-term monitoring of groundwater gradients, contaminants, and other parameters as appropriate
- Evaluation and possible implementation of innovative technologies that may provide a comparable or higher degree of performance, and that are as, or more cost-effective than the demonstrated technology in containing or preventing the contamination from migrating northward into the Peele-Dixie Wellfield.

Monitored Natural Attenuation

- Natural attenuation of groundwater contaminants throughout Site groundwater plume that exceeds MCLs
- Reduced contaminant levels through natural intrinsic biological and chemical processes, as indicated by results from the RI
- Long-term groundwater monitoring to ensure attainment and long-term compliance with MCLs
- Long-term groundwater monitoring to ensure that the groundwater plume is degraded and does not pose a threat to other drinking water resources.

8.2 <u>Common Elements and Distinguishing Features of Each Alternative</u>

With the exception of the No-Action Alternative (GW1), each of the alternatives is designed to be protective of human health and the environment and compliant with applicable or relevant and appropriate requirements (ARARs). The remaining alternatives, monitored natural attenuation (MNA) (GW2), Source Remediation and MNA (GW3), and Source Remediation, Wellfield

Protection, and MNA (GW4), are similar in nature in that they are all designed to reduce VOC contaminant levels within the aquifer to within MCLs. The main difference between the alternatives is the cost, the amount of time required to achieve MCLs, and degree of protection being provided to the Peele-Dixe Wellfield while the groundwater remediation is ongoing. In general, as the amount of time decreases for groundwater cleanup and the degree of wellfield protection increases, the cost of the overall cleanup increases. Section 9.0 of this ROD will include an analysis of the alternatives that attempts to balance the differences in cleanup times, cost, protection of human health, attainment with ARARs, and wellfield protection with increases in cost.

Applicable or Relevant and Appropriate Requirements

The primary ARARs that must be complied with are federal and state MCLs. Although modeling predictions indicate that the No-Action Alternative would eventually comply with MCLs through natural intrinsic chemical and biological degradation processes, the remedy would include no groundwater monitoring to ensure that the MCLs are met within the predicted time frame or that the plume would not threaten other drinking water resources prior to attainment of MCLs.

Alternatives GW2, GW3, and GW4 would all include MNA as a basic component of the remedy. Groundwater monitoring would provide data necessary to assess the performance of the remedy and to ensure that the plume did not threaten other drinking water resources. In the event that the remedy did not perform as anticipated, groundwater monitoring would serve as an "early warning" notice so that other protective measures could be employed.

Alternatives GW3 and GW4 would incorporate the pumping and treating of groundwater at the FPR facility. Groundwater modeling estimates suggest that the collection and treatment of highly contaminated groundwater at the FPR facility will reduce the period of time in which MCLs are met for the overall plume by about 50 percent.

Alternative GW4 includes a unique component in that containment measures would be taken south of the wellfield to protect the wellfield. For planning purposes, it is assumed that a hydraulic containment barrier would be implemented in the vicinity of the North New River Canal. This barrier would serve to protect the wellfield from further contamination from the northern portion of the plume, including the secondary source area and the FPR facility, which exceeds primary drinking water standards. While implementation of a containment system would not necessarily reduce the period of time for attainment of MCLs throughout the aqueous plume, it would prevent the northward migration of the plume, thus significantly reducing the threat to the Peele-Dixie Wellfield.

Long-Term Reliability

The No-Action Alternative would not include any provisions for long-term monitoring and, therefore, could not be assessed for long-term reliability or whether contingent remedies might need to be implemented.

Each of the other alternatives, GW2, GW3, and GW4, would include provisions for long-term monitoring to provide data that could be used to assess the long-term performance of the remedy. Long-term monitoring would also provide data that could be used to monitor the need for the implementation of other treatment measures in the event that the selected remedy was not performing as planned or other drinking water resources were potentially threatened.

Alternatives GW3 and GW4 would be expected to further increase the long-term reliability of the remedy, since they would both incorporate the pumping and treating of groundwater at the FPR facility. Remediation of the source area would be expected to further increase the long-term reliability by reducing the mass of contaminants that otherwise would need to be addressed through natural attenuation processes.

Finally, Alternative GW4 would incorporate an even higher level of long-term reliability through the installation of a containment system near the Peele-Dixie Wellfield. Use of protective measures near the wellfield would further reduce the potential for further contamination of the wellfield and significantly shorten the period of time the wellfield would need to operate in a reduced state of pumping.

Quantity of Untreated Waste or Treatment Residuals

Each of the alternatives, including the No-Action Alternative, involves the treatment of contaminated groundwater through intrinsic natural chemical and biological processes. Based on groundwater modeling predictions, each of the alternatives would be expected to eventually result in the treatment of all contaminants and would not leave any untreated waste or treatment residuals. As discussed previously, the main distinction among the alternatives is the amount of time and costs required for the treatment of the groundwater to occur to attain MCLs.

Estimated Time for Design and Construction

In general, beginning with the No-Action Alternative, GW1, the alternatives increase in terms of the amount of time required for design and construction. This is primarily due to the increase in complexity of the alternatives. Following is a summary of the estimated time for design and construction of the remedies.

Remedy	Est. Design Time[1]	Est. Const. Time	Total Implementation Time
GW1 - No Action	0	0	0
GW2 - MNA	3	1	4
GW3 - Source Remediation & MNA	4	3	7
GW4 - Source Remediation, Wellfield Protection & MNA	6	6	12

Notes: [1] - Time estimates in number of months.

Estimated Time to Reach Remediation Goals

As discussed previously, one of the primary differences among the alternatives is the estimated time needed to achieve MCLs and the degree of protection provided to the wellfield during the restoration efforts of the Biscayne aquifer. Following is a summary of the estimated cleanup times.

Remedy	Est. Time to MCLs[1]	Est. Time of Restricted Wellfield Pumping[2]
GW1 - No Action	27	10
GW2 - MNA	27	10
GW3 - Source Remediation & MNA	15	10
GW4 - Source Remediation, MNA, and Wellfield Protection	15	2

Notes:
[1] - Time estimates in number of years.
[2] - Estimated time required for wellfield to remain in a reduced state of pumping, until contaminant levels are reduced to a point that they no longer pose a threat of recontamination of the wellfield if pumping is increased.

Estimated Costs

Another area of difference among the alternatives is the estimated costs of remediation. A summary of the estimated costs expressed in terms of capital cost (i.e., the cost of construction), long-term cost, annual O&M cost, and the total present worth cost of the remedy follows. The total present worth cost of a remedy represents the total costs of construction and long-term operation and maintenance multiplied by a discount factor that takes into account the amount of interest earned. This cost assumes that the total amount of capital and O&M costs needed for the remedy are invested and dispersed over time. The discount rate used in the calculation of the total present worth costs was 7 percent. Following is a summary of the estimate costs.

Remedy	Capital Cost	Avg. Annual O&M	Total Present Worth Cost
GW1 - No Action	0	0	0
GW2 - MNA	$98,000	$53,232	$846,000
GW3 - Source Remediation & MNA	$436,000	$197,431	$2,287,000
GW4 - Source Remediation, Wellfield Protection & MNA	$1,062,000	$272,657	$3,970,000

Use of Presumptive Remedies or Innovative Technologies

In general, each of the alternatives would rely on the use of reliable demonstrated technologies. Each of the alternatives would incorporate natural attenuation, which has been shown to be effective in the treatment of VOCs present in the groundwater at the FPR Site. Alternatives GW3 and GW4 would incorporate pumping and treating technologies that also have been shown to be effective in the remediation of VOC contaminated groundwater. GW3, Source Remediation, and GW4, which incorporates contaminant containment technology for wellfield protection, are the only alternatives that provide for the possible use of innovative technologies.

Alternative GW4 would provide for the protection of the Peele-Dixie Wellfield through the construction of a containment system that would separate the contaminants that exceed primary drinking water standards in the northern portion of the plume, the secondary source area, and the FPR facility from the wellfield. For planning and cost estimate purposes, it was assumed that a hydraulic containment barrier, which has been shown to be effective in the control of groundwater flow, would be used to create the containment system. However, there may be other innovative technologies (i.e., metal-enhanced reductive dechlorination, hydrogen-release compounds, or enhanced bioremediation) or wellfield protection system that could be used to create a containment system that would provide an equivalent or superior degree of performance and/or cost-effectiveness than a conventional hydraulic containment barrier. Treatability studies would need to be conducted during the remedial design to evaluate the potential applicability of such innovative technologies and systems.

8.3 Expected Outcomes of Each Alternative

Each of the alternatives are expected to eventually result in the reduction of contaminant levels in the aquifer to within MCLs. At that point, use of the Biscayne aquifer would no longer be impaired due to contamination from the FPR Site and the secondary source area. As noted earlier, the main difference among the alternatives is the rate at which contaminants are reduced to within MCLs. As contaminants in the groundwater are reduced to MCLs, the groundwater would be available for use. Groundwater modeling estimates indicate that the outer boundaries of the plume would achieve MCLs first, with the area closest to the FPR facility taking the longest amount of time to reach MCLs.

Alternative GW4 would provide an added benefit in that it would incorporate a containment system that would prevent the wellfield from recontamination from the northern portion of the plume, including the second source area and the FPR facility. This would allow the City of Fort Lauderdale to begin the process of increasing the pumping from the Peele-Dixie Wellfield to attain pre-1986 pumping rates. Alternatives GW1 through GW3 would require that the wellfield remain in a reduced state of pumping until such time as groundwater contaminant levels were reduced in the wellfield to a point they no longer posed a threat to the wellfield.

9.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The following text summarizes the comparative analysis of alternatives presented in the FSA using the nine criteria established in Title 40 Code of Federal Regulations (CFR) Section 300.430(e)(9)(iii). This summary documents the key points used in the selection of the remedy for the Site. It is based on a comparison of the relative performance of the alternatives relative to the nine criteria defined in the following paragraphs.

In developing an overall Site remedy, EPA considered alternatives that provide the best balance and value among the nine criteria for achieving the protection of human health and the environment and that comply with ARARs. Since the No-Action Alternative would not meet the threshold criteria of protection of human health and the environment and compliance with ARARs, it is not included in the evaluation of alternatives.

These alternatives are summarized and analyzed using the threshold and balancing criteria provided in 40 CFR 300.430(e)(9)(iii), which include overall protection of human health and the environment and compliance with ARARs. In order for an alternative to be considered for selection, it must meet these two threshold criteria.

Five balancing criteria used to identify and balance the trade-offs among alternatives include the following:

- Long-term effectiveness and permanence
- Reduction in toxicity, mobility, and volume of contaminants through treatment
- Short-term effectiveness
- Implementability
- Cost.

Two modifying criteria included in 40 CFR 300.430(e)(9)(iii) are state and community acceptance. These are used to further evaluate and distinguish between alternatives that may otherwise achieve a comparable level of protection, compliance with ARARs, and cost.

Each of the groundwater alternatives would be required to meet both federal and state drinking water standards for all VOCs related to releases from the FPR Site and secondary sources. Upon attainment of these standards, the remedy would be deemed complete. Chemicals of concern that would be monitored during the action include PCE, TCE, 1,1,1-TCA, 1,1-DCA, 1,2-DCE, 1,1-DCE, and vinyl chloride.

9.1 <u>Threshold Criteria</u>

9.1.1 Overall Protection of Human Health and the Environment

This criterion addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Each of the three active remedial alternatives, GW2, GW3, and GW4, would be protective of human health and the environment. A significant primary difference among the alternatives is the rate at which the alternatives achieve protection and the level of protection of the Peele-Dixie Wellfield. Alternatives GW3 and GW4 would incorporate collection and treatment of contaminated groundwater at the FPR facility to further reduce the mass of contamination at the facility and accelerate the attenuation of the plume of contamination. The estimated time for attainment of MCLs for alternatives GW3 and GW4 is 15 years. Without the collection and treatment of contaminated groundwater at the source area, MNA would be expected to achieve MCLs within about 27 years.

Alternative GW4 would incorporate a containment system near the Peele-Dixie Wellfield that would allow for the increased pumping of the wellfield after its installation. Alternatives GW2 and GW3 would require that the wellfield remain in a restricted state of pumping until such time as contaminants in the vicinity of the North New River Canal had been reduced to levels that no longer pose a threat to the wellfield. Groundwater modeling estimates indicate that Alternatives GW2 or GW3 would take approximately 10 years to reduce contaminant levels in the vicinity of the wellfield before pumping in the wellfield could resume at historical levels.

9.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes and/or provide grounds for invoking a waiver.

As with protection of human health and the environment, each of the active remedial alternatives, GW2, GW3, and GW4, would comply with ARARs. While certain state and federal regulations would need to be followed during the implementation of the remedy, state and federal drinking water standards would be the primary ARAR for determining the effectiveness and completion of the remedy. Based on attainment of MCLs, Alternatives GW3 and GW4 would be expected to attain ARARs in the shortest period of time. Alternative GW2, which would rely on MNA alone, would be expected to take roughly twice as long as Alternatives GW3 and GW4 to reduce contaminant levels to MCLs.

9.2 Primary Balancing Criteria

9.2.1 Long-Term Effectiveness and Permanence

This criterion refers to the magnitude of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

Alternative GW4 would be expected to offer the greatest degree of long-term protection and permanence and it would be greatly shorten the period of time that the City of Fort Lauderdale would have to operate the Peele-Dixie Wellfield on a restricted basis. Alternatives GW4 and GW3 would both accelerate the reduction of contaminants and attainment of MCLs through the collection and treatment of contaminated groundwater at the FPR source area. While Alternative GW2 would be expected to ultimately reduce the contaminant levels to within MCLs, it would be expected to take twice as long as the other alternatives.

9.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion refers to the anticipated performance of the treatment technologies that may be employed in a remedy.

Alternative GW4 would be expected to offer the highest degree of performance with regard to reducing the toxicity, mobility, and volume of contaminants. Although GW3 and GW4 would both incorporate the collection and treatment of groundwater at the FPR source area, GW4 would be expected to offer a superior level of performance through the installation of a containment system south of the Peele-Dixie Wellfield. Depending on the technology used to contain the contaminants, it would be expected to further reduce the toxicity, mobility, and volume of the plume in the vicinity of the wellfield.

9.2.3 Short-Term Effectiveness

This criterion refers to how quickly the remedy achieves its designed level of protection, as well as the potential adverse impacts on human health and the environment that may occur during construction and implementation of the remedy.

Alternative GW4 would be expected to achieve overall protection at the Site and the Peele-Dixie Wellfield in the shortest period of time. Although attainment of MCLs throughout the entire groundwater plume are estimated to be the same as for GW3, a secondary benefit with Alternative GW4 is that it would significantly expedite the renewed pumping of the Peele-Dixie Wellfield at historical levels.

Alternative GW2, MNA, would be expected to pose the least degree of short-term risks. Since implementation of GW2 would only involve the installation and monitoring of groundwater wells, it would not be expected to pose any short-term risks to workers or the community.

Alternatives GW3 and GW4 would be expected to present a potentially higher degree of short-term risk due to the increased construction activities involved with the construction of the recovery and treatment system. Due to the construction of the containment system, Alternative GW4 would involve the most construction, and would be expected to present the greatest degree of potential short-term risk.

Nevertheless, all of the alternatives would employ standard construction practices that would incorporate health and safety measures to minimize any potential risks to workers or the nearby community that may occur during construction.

9.2.4 Implementability

This criterion refers to the technical and administrative feasibility of a remedy, including availability of materials and services required for implementation.

Alternative GW2 would be easier to implement, since it would involve the least amount of construction and administrative issues such as access and permits. Alternatives GW3 and GW4 would require a higher degree of effort to install the groundwater recovery and treatment system and hydraulic barrier system. This effort would primarily require additional planning and field construction activities. Incorporation of a containment system in Alternative GW4 would require the greatest degree of planning and field construction.

9.2.5 Cost

This criterion assesses the capital and O&M costs associated with the proposed remedial alternatives.

The cost of the alternatives increases based on the effort used to improve the effectiveness and performance of the remedy for achieving MCLs in the shortest period of time while minimizing the impact on the Peele-Dixie Wellfield operations. Accordingly, the least costly remedy is Alternative GW2, MNA, at a total present worth cost of $846,000. The total present worth cost of GW3 is estimated at $2,287,000. The most expensive alternative is GW4, with a total present worth cost estimated at $3,970,000.

9.3 Modifying Criteria

9.3.1 State Support/Agency Acceptance

This criterion indicates whether, based on its review of the RI and FS reports and draft Proposed Plan, the state would be expected to concur with, oppose, or have no comment on the preferred alternative.

EPA has consulted with both the FDEP and South Florida Water Management District (SFWMD) throughout the RI/FS process and in the development of the Proposed Plan. Both FDEP and SFWMD have indicated that they strongly support a cleanup approach that attempts to actively reduce the volume and mobility of contaminants and provides for the rapid protection of the Peele-Dixie Wellfield. If active restoration of the FPR source area and protection of the Peele-Dixie Wellfield are incorporated into the overall Site remedy, FDEP believes that MNA would be an acceptable remedial alternative for the large aqueous plume.

9.3.2 Community Acceptance

This criterion is assessed in the Responsiveness Summary section of the ROD following the review of public comments on the FS report and Proposed Plan.

Comments received from the community during the comment period and from the public meeting indicate that the community prefers Alternative GW4. This alternative would reduce the amount of time for the groundwater plume to achieve MCLs, and would minimize the amount of time that the Peele-Dixie Wellfield would need to operate in a restricted state of pumping.

In contrast, the PRPs for the Site do not feel that a barrier containment system outlined in Alternative GW4 is needed. The PRPs are of the opinion that pumping at the Peele-Dixie Wellfield could be increased gradually, and that the added expense of constructing a containment barrier system to protect the wellfield is not worth the 10- to 12-year projected reduction in time needed to keep the wellfield in a restricted state of pumping.

10.0 PRINCIPAL THREAT

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (40 CFR 300.430[a][1][ii][A]). In general, principal threats generally include contaminated liquids, areas with high concentrations of toxic compounds, and highly mobile materials which if not contained in a reliable manner could present a significant threat to human health or the environment should exposure occur.

The principal threats at the FPR Site are considered to be the residual DNAPL present in the subsurface soil at the facility and the associated highly contaminated groundwater in this area. If these contaminants are not addressed, they will continue to pose a long-term threat to the Biscayne aquifer. Plans are currently in place to address the residual DNAPL implemented in November 2000. Thus, that portion of the principal threat has been conceptually addressed.

In addition, highly contaminated groundwater located at the FPR facility and the aqueous plume are considered to represent a principal threat as well. Contamination from this facility has already impacted one municipal drinking water supply and, if not addressed, could pose a long-term threat to the Biscayne aquifer.

11.0 SELECTED REMEDY

11.1 Summary of Rationale for the Selected Remedy

Based on the consideration of the requirements of CERCLA, as amended by SARA, the detailed analysis of the alternatives, and the public comments received on the Proposed Plan, EPA, in consultation with FDEP, has determined that a variant of Alternative GW4 (Source Remediation, Wellfield Protection, and MNA) would be the most appropriate remedy for the Site. Not only will it be effective in reducing groundwater contaminant levels to MCLs in a reasonable period of time, it will also have the secondary effect of protecting the water derived from the southern portion of the Peele-Dixie Wellfield and allowing the City to resume historical pumping of the wellfield on an expedited basis.

EPA believes that Alternative GW4 provides the best balance of "trade-offs" among the nine criteria specified in the NCP. EPA believes that this alternative will be protective of human health and the environment, comply with ARARs, be cost-effective, and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. This remedy will also satisfy the statutory preference for treatment. EPA recognizes that there are other alternatives that may be less costly in the short-term, but EPA is concerned that they would not provide the same degree of treatment of the contaminated groundwater.

The scope of the remedy set forth in the Proposed Plan provided for the monitored natural attenuation of the large aqueous plume, the collection and treatment of contaminated groundwater at the FPR facility, and the protection of the Peele-Dixie Wellfield through the containment of the northern portion of the plume via a hydraulic barrier. EPA identified this remedy as its preferred alternative in the Proposed Plan. However, based on comments received during the public comment period and subsequent discussions with all stakeholders involved in this project, EPA determined that while Alternative GW4 was still the most appropriate remedy, a modification to the remedy was appropriate.

This change to the remedy pertains to the treatment of contamination in the northern portion of the groundwater plume and the protection of the southern portion of the Peele-Dixie Wellfield. During the preparation of the FS Addendum and the Proposed Plan (June 2000), EPA developed a remedial alternative that would have the added effect of protecting the Peele-Dixie Wellfield without actually intruding into the wellfield to implement the remedy. This approach was consistent with the City of Fort Lauderdale's concern with being involved in the long-term operation and maintenance of a groundwater recovery and treatment system to remove VOCs from the groundwater in its wellfield. In 1994, the City took the lead to control the spread of VOCs in the Peele-Dixie Wellfield by installing and operating a pump and treat system as part of a removal action.

Shortly after the end of the public comment period on the September 2000 Proposed Plan, the City completed its long-range master plan for the City of Fort Lauderdale's future water needs. From the results of this study the City concluded that the entire volume from the Peele-Dixie Wellfield will be needed meet its water needs. The City concluded that increased pumpage from the wellfield was necessary in the near term, and thus, reconsidered its former position of not wanting to allow the use of the wellfield as a part of a long-term groundwater remediation system for the FPR site. The City advised EPA that while it still supports the remedial approach contained in Alternative GW4, it believes that the pumping and treating of water collected at the Peele-Dixie Wellfield entails a remedy that is more protective and quicker to implement.

EPA received other comments that suggested the most cost-effective approach to treat the groundwater and protect the wellfield would be to install and operate an air stripping system at the wellfield to treat contamination that may result from the renewed historical pumping of the wellfield. The comments also noted that this approach would provide a secondary, although important, benefit to the City in that it would ensure a safe supply of drinking water in the event contamination circumvented the barrier system outlined in GW4. In-light of the determinations by the City of Fort Lauderdale and consideration of other comments, EPA concluded that the pumping and treating of contaminants at the wellfield would be a more reliable and cost-effective approach to treat the groundwater and protect the wellfield, compared to the containment of the plume through the implementation of a hydraulic barrier system.

The total present worth cost of Alternative GW4 as outlined in the Proposed Plan was estimated at $3,970,000. As a result of the changes in the selected remedy, however, the total present worth cost is now estimated at approximately $4,200,000. The nominal increase in cost is due to a slight increase in cost associated with the pumping and treating in the wellfield. This increase in cost is offset by the improvements in implementability and reliability of the remedy. As noted in the EPA ROD guidance, this cost is an order of magnitude engineering cost estimate that was developed as part of the FS to compare cost-effectiveness among alternatives. The cost estimate is expected to vary from the actual cost based on additional information collected during the remedial design process. Once complete, this alternative will attain MCLs and reduce the Site risks to within EPA's acceptable risk range of 1×10^{-4} to 1×10^{-6}.

In summary, the modified version of Alternative GW4 includes source remediation at the facility, monitored natural attenuation of the aqueous plume, and remediation of the northern portion of the plume through the pumping and treating of the contaminated groundwater at the wellfield. A secondary benefit with this approach is that the Peele-Dixie Wellfield will be able to resume the unrestricted pumping of the wellfield at historical pumping levels without the threat of contaminating the City of Fort Lauderdale's drinking water supply above MCLs.

11.2 Description of the Selected Remedy

11.2.1 Major Components

The selected remedy includes 1) remediation of the groundwater at the FPR facility; 2) monitored natural attenuation of the groundwater contamination released from the FPR facility and FDOT I-595 source areas; and 3) the pumping and treating of contaminated groundwater above MCLs which may enter the Peele-Dixie Wellfield when historical pumping rates are resumed. As described below, MNA and pumping and treating of groundwater will be conducted for contaminants which exceed the drinking water standards in Section 11.2.2 of this ROD.

Source Remediation

The Proposed Plan issued in June 2000, discussed the presence of concentrated levels of VOCs in the soil and groundwater at the FPR facility that were deemed to represent a long-term source of contamination. As noted in the Plan, a removal action was being developed to address the residual DNAPL and associated groundwater contamination at the facility. This work was started in November 2000, and is expected to be completed by April 2001. At a minimum, this removal action will address the residual DNAPL at the facility.

While the removal action is expected to reduce groundwater contaminant levels at the source area as well, it may not be effective in reduction of groundwater contaminants at the facility that may pose a long-term threat to groundwater. Groundwater modeling estimates indicate that groundwater contaminants that remain at the facility after the removal action may be detrimental to the natural attenuation of the large aqueous groundwater plume and could extend the overall cleanup time of the groundwater by up to 12 years.

In the event that contaminants remain in the groundwater at the FPR facility after the DNAPL removal action is complete, groundwater remediation will be conducted as outlined in Alternative GW4. For the purpose of determining if groundwater remediation beyond the removal action is needed, the following criteria will apply. The property boundary for the FPR facility will be used to establish the point of compliance. Monitored Natural Attenuation default criteria established by the FDEP pursuant to Florida Administrative Code 62-777 will be used as the point of departure for determining if groundwater remediation at the facility as specified in Alternative GW4 will be needed. In general, the default criteria is 100 times the MCL for carcinogenic contaminants and 10 times the MCL for non-carcinogenic contaminants. If contaminants exceed this criteria after the completion of the DNAPL removal action, pumping and treating of groundwater as outlined in Alternative GW4 will be implemented and continued until these levels are achieved.

The scope of this portion of the remedy will involve the collection and treatment of contaminated groundwater within the facility boundary, that exceeds the State's natural attenuation default criteria. It is estimated that groundwater will be extracted at a total rate of approximately 100 gallons per minute. The contaminated water will be treated at the facility via air stripping, and the treated water will then be reinjected into the aquifer underlying the FPR facility. The pumping and treating of groundwater may be terminated once the groundwater contaminant levels have been shown to be permanently below the State's natural attenuation default criteria. Regardless if the groundwater at the facility is addressed through the DNAPL removal or requires additional remediation through pumping and treating, it must still achieve MCLs through MNA as with the rest of the plume.

A listing of the major components of the groundwater recovery and treatment system at the FPR facility includes:

- Groundwater recovery/extraction wells
- Water pumps
- Air stripping system and controls
- Infiltration system
- Groundwater monitoring wells
- Equipment pad
- Electrical services.

Wellfield Protection

A secondary component of the remedy will be the protection of water derived from the southern portion of the Peele-Dixie Wellfield by collecting and treating groundwater contaminants contained in the northern portion of the Site plume. The contaminants in this part of the plume are expected to enter the cone of influence of the wellfield as a result of the increased pumping of the wellfield at historical levels. This remedy will collect and treat groundwater contaminants in excess of drinking water standards (in Section 11.2.2 of this ROD). Although actions taken by the City have successfully controlled the spread of contaminants and reduced contaminant levels in the wellfield to levels below federal and state drinking water standards, contaminants above these standards remain south of the wellfield in the vicinity of the North New River Canal. Historical and current groundwater contaminant levels indicate that if pumping of the wellfield resumes at historical levels, contaminants south of the wellfield will migrate northward and re-contaminate the wellfield at levels above MCLs.

For planning and cost estimating purposes, the selected remedy assumes that pumping in the southern part of the Peele-Dixie Wellfield will be increased to its historical average rate of 7 mgd. It was assumed that the existing wells will essentially serve as the groundwater recovery wells for the pumping system. However, new piping will be installed so that flows from contaminated and non-contaminated wells can be separated. Contaminated groundwater would be transferred via pipeline for treatment through an air stripping system. The location of the treatment system will be determined during the remedial design based on reliability, cost, accessibility, implementability, maintenance, and community acceptance considerations.

It is assumed that analytical data and other appropriate information will be used to design and implement the air stripping system in a manner so as to maximize the selected remedy's primary goal of treatment of contaminated groundwater. As previously noted, the system will initially be designed and built to treat an average pumping rate of 7 mgd. Since contaminant levels are expected to vary in concentration among the wells in the southern portion of the wellfield, the system design should have the capability to divert contaminated groundwater for treatment via air stripping prior to transferring water to the Peele-Dixie Wellfield plant. Likewise, the system should have the capability to divert non-contaminated groundwater directly to the plant for processing and distribution.

Over time, it is anticipated the extent of contamination and wellfield impacts will be diminished to the point that the treatment of groundwater from various wells will no longer be needed. As more wells become progressively cleaner, the air stripping treatment capacity and monitoring requirements may be reduced accordingly.

A list of the major components used for planning and cost estimating purposes for the groundwater pump and treat system includes:

- Groundwater recovery wells
- Air stripping and system controls
- Water/transfer pumps
- Transfer piping
- Electrical services
- Equipment pad/buildings.

The treatment system will incorporate a rigorous groundwater monitoring program in the vicinity of the Peele-Dixie Wellfield. While this program may incorporate some of the same monitoring wells used to monitor for natural attenuation, monitoring is expected to be conducted at a higher frequency to ensure full protection of water derived from the southern portion of the Peele-Dixie Wellfield. At a minimum, this monitoring program will evaluate changes in contaminant levels and groundwater gradients, and the effectiveness of the treatment system.

EPA recognizes that pursuant to 40 CFR § 300.345(f)(4)(ii), groundwater treatment for the primary purpose of providing a drinking water supply is not normally deemed to constitute treatment measures to restore contaminated groundwater. Although the treated groundwater may ultimately be used by the City of Fort Lauderdale to augment its water supply, this remedy is being performed for the primary purpose of removing and treating groundwater contaminants present in the northern portion of the site plume. The secondary effect of the remedy is that it will restore the groundwater resource such that it no longer poses a threat to the wellfield. After consideration of comments received on the Proposed Plan and discussion of the comments with each of the stakeholders for this site, EPA balanced the short-term and long-term risks associated with spending more time and money to design an effective hydraulic containment system versus treating the contaminated groundwater at the wellhead to restore the resource. EPA determined that pumping and treating the groundwater contaminants at the wellfield would be a more reliable and cost-effective approach.

Monitored Natural Attenuation

The final component of the selected remedy entails MNA of the large aqueous plume. Groundwater modeling estimates of groundwater flow and fate and transport of contaminants, along with an assessment of the effectiveness of the ongoing intrinsic chemical and biological processes, indicate that natural attenuation will be an effective means for reducing the Site's large volume of low-level groundwater contamination. Modeling estimates indicate that MNA, coupled with the pumping and treating of groundwater, should reduce contaminant levels throughout the plume to within MCLs within approximately 15 years. Transport simulations indicate that the plume will not migrate significantly and will gradually decrease in size. The groundwater area at the FPR facility will take the longest amount of time to attain MCLs. Figure 11-1 depicts the projected changes in the plume as the attenuation progresses.

Implementation of the MNA component of the remedy will only involve the development and implementation of a long-term groundwater monitoring program. This program will involve the monitoring of wells throughout the groundwater plume for releases of contaminants from the FPR facility and the secondary source area at I-595 that exceed either state or federal MCLs.

A summary of the minimum requirements of a groundwater monitoring program includes:

- Representative monitoring of existing and newly installed wells
- Establishment of the downgradient extent of the groundwater plume in representative zones of the aquifer that are comparable to zones formerly investigated during the Remedial Investigation

LEGEND:
Red - greater than100 parts per billion (ppb)
Light Blue - 10 to 100 ppb
Dark Blue - less than 10 ppb

Figure 11-1
Projected Plume Attenuation Process for Selected Remedy
Florida Petroleum Reprocessors, Davie, Florida

- Monitoring and reporting of groundwater contaminant levels, water levels, and other appropriate indicator chemicals throughout the plume (excluding performance monitoring requirements associated with groundwater pump and treat actions)
- Five-year reviews of the performance of MNA.

11.2.2 Performance Standards

Performance standards presented in this section establish the levels of cleanup to be achieved by this remedy, along with any other major performance standards governing the construction or operation of the remedy. Although these performance standards are based on ARARs that apply to this type of action, they may include other design and implementation criteria as appropriate. All on-Site actions shall be performed in accordance with the substantive requirements of applicable federal, state, and local laws and regulations. The procurement of permits will not be required for on-Site actions. A summary of ARARs to be achieved is provided in Table 11-1.

Groundwater shall be treated through natural attenuation until the following MCLs are attained at the groundwater monitoring wells designated by EPA as compliance points. Compliance points will be established by EPA through development and approval of the groundwater monitoring plan. These standards are based on federal and state MCLs for the contaminants with the greatest frequency of detection and distribution. Although other contaminants were detected, they were detected with less frequency and will be addressed during the removal of the following contaminants.

Contaminant	Concentration ($\mu g/L$)
1,1-DCE	7
cis-1,2-DCE	70
PCE	3[1]
1,1,1-TCA	200
TCE	3[1]
Vinyl Chloride	1

[1] - State Drinking Water Standard

In the event that pumping and treating of groundwater at the FPR facility is required, it will be conducted until the following criteria are achieved. The natural attenuation default criteria as specified in FAC 62-777 for the contaminants at FPR are:

Contaminant	Concentration ($\mu g/L$)
1,1-DCE	700
cis-1,2-DCE	700
PCE	300
1,1,1-TCA	2000
TCE	300
Vinyl Chloride	100

The remaining contamination will be reduced to the previously specified MCLs through MNA.

Table 11-1
Summary of ARARs for the Selected Remedy
Florida Petroleum Reprocessors
Davie, Florida

Selected Remedy Component	Major Components	ARARs
Source Remediation	• Groundwater extraction wells • Air stripping • Treatment of air emissions as necessary • Groundwater disposal via infiltration gallery	Contaminant-Specific • Federal and state groundwater classifications (55 CFR 8732 and FAC 62-520) • Safe Drinking Water Act (40 CFR 141) • Florida Drinking Water Standards (FAC 62-550) • Clean Air Act (40 USC 7401 et seq.) • Florida Air Emission Standards (FAC 62-204) Action-Specific • Florida Underground Injection (FAC 62-528)
Wellfield Protection	• Groundwater extraction wells • Air stripping • Treatment of air emissions as necessary • Groundwater disposal via injection wells	Contaminant-Specific • Federal and state groundwater classifications (55 CFR 8732 and FAC 62-520) • Safe Drinking Water Act (40 CFR 141) • Florida Drinking Water Standards (FAC 62-550) • Clean Air Act (40 USC 7401 et seq.) • Florida Air Emission Standards (FAC 62-204) Action-Specific • Florida Underground Injection (FAC 62-528)
Monitored Natural Attenuation	• Groundwater monitoring and annual reporting • Five-year review with comprehensive analysis of remedy's protectiveness	Contaminant-Specific • Federal and state groundwater classifications (55 CFR 8732 and FAC 62-520) • Safe Drinking Water Act (40 CFR 141) • Florida Drinking Water Standards (FAC 62-550)

11.2.3 Extraction Standards

FPR Facility

Based on groundwater modeling estimates, groundwater will be extracted at or near the FPR facility at a minimum rate of 100 gallons per minute. The modeling assumed that the groundwater would be collected through two pumping wells screened at an interval designed to capture groundwater contaminants within the highly transmissive zone of the Biscayne aquifer.

Peele-Dixie Wellfield

Pumping rates in the southern portion of the Peele-Dixie Wellfield will be based on the historical pumping average of 7 mgd.

11.2.4 Treatment Standards

At a minimum, the air strippers shall be designed to remove contaminant levels to meet the compliance standards listed in Table 11-1 to nondetectable levels by one pass through the air stripping column. Consideration shall also be given to selecting a system design that is compatible with the water quality encountered in the south Florida area in an effort to minimize fouling and maintenance requirements. The system will also include access ports to obtain samples for verification of system performance and maintenance.

In addition to groundwater monitoring standards, off-gases from the air stripper shall be monitored and treated, as appropriate, to comply with all ARARs.

11.2.5 Discharge Standards

Discharges from the groundwater treatment system shall comply with all ARARs, including, but not limited to, substantive requirements of the National Pollutant Discharge Elimination System permitting program under the Clean Water Act, 33 U.S.C. §§1251 et seq. Discharge standards shall also be subject to the substantive requirements of the Florida Administrative Code (FAC 62-528) that establishes criteria for underground injection.

11.2.6 Design Standards

The design, construction, and operation of the groundwater treatment system shall be conducted in accordance with all ARARs, including the Clean Air Act requirements set forth in 40 U.S.C. § 7401.

11.2.7 Performance Monitoring and Compliance Testing

Performance monitoring during implementation will optimize operation of the extraction and treatment system and will demonstrate successful treatment of the extracted groundwater prior to discharge. A monitoring plan will be developed in accordance with the 1994 EPA guidance titled *Methods of Monitoring Pump-and-Treat Performance.*

After demonstration of compliance with performance standards for the groundwater, the groundwater shall be monitored for a period of time sufficient to demonstrate that the attainment of the performance standards are permanent. If monitoring indicates that the performance standards set forth in Section 11.2.7 are consistently being exceeded, appropriate actions (i.e., groundwater pumping and treatment, MNA, etc.) will be taken until the performance standards are once again achieved. This process will continue until permanent compliance with the performance standards is demonstrated, or it is demonstrated that compliance is technically impracticable and a compliance waiver is justified and approved by EPA.

11.3 Summary of the Estimated Remedy Costs

Table 11-2 includes a summary of the estimated cost for the selected remedy. The information included in the cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as new information and data are collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences, or a ROD amendment. This is an order of magnitude engineering cost estimate that is expected to be within plus 50 percent to minus 30 percent of the actual project cost.

11.4 Expected Outcomes of the Selected Remedy

The results expected from the implementation of the selected remedy entail restoring a portion of the Biscayne aquifer impacted by this Site to its beneficial use as a potable water supply source. Groundwater contaminants associated with this entire Site are estimated to be reduced to within MCLs within 15 years.

This remedy will also facilitate the expanded use of the Peele-Dixie Wellfield by the City of Fort Lauderdale. It is anticipated that upon implementation of this remedy, the City of Fort Lauderdale can resume the pumping of water from the Peele-Dixie Wellfield at the 1986 pre-contamination rates.

With regard to the FPR facility, the property will eventually be available for commercial/ industrial use consistent with the surrounding area. All contaminated soils that could pose a threat to future occupants have already been addressed through removal actions. If after the completion of the ongoing removal action contaminant levels are reduced to within the State's natural attenuation default criteria, the property should be available for reuse within the next few years. If pumping and treating of the groundwater is needed at the facility to reduce contaminant to within MCLs, the FPR property may not be available for use for many years.

Table 11-2
Cost Estimate for Selected Remedy
Florida Petroleum Reprocessors
Davie, Florida

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Capital Cost for Remedy Component 1 (Pump and Treat with Air Stripper Towers)
Two (2) 12'-diameter air stripping towers; feed pumps; 20", 16", and 14" welded steel piping with miscellaneous valves and fittings; 12", 10", and 8" welded steel piping with miscellaneous valves and fittings; concrete; and Level D.

Description	Quantity	Unit	Unit Cost	Cost
1. Site Work				
Excavation for Structures and Utilities				
Feed Lines to/from Towers	1	LS	$5,500.00	$5,500.00
Pump Station	1	LS	$5,500.00	$5,500.00
Subtotal				**$11,000.00**
2. Piping				
Welded Steel Pipe (20" diameter)	720	LF	$66.00	$47,520.00
Miscellaneous Valves and Fittings	1	LS	$20,000.00	$22,000.00
Welded Steel Pipe (16" diameter)	1,600	LF	$49.50	$79,200.00
Miscellaneous Valves and Fittings	1	LS	$20,000.00	$22,000.00
Welded Steel Pipe (14" diameter)	1,440	LF	$41.80	$60,192.00
Miscellaneous Valves and Fittings	1	LS	$20,000.00	$22,000.00
Welded Steel Pipe (12" diameter)	1,840	LF	$33.00	$60,720.00
Miscellaneous Valves and Fittings	1	LS	$20,000.00	$22,000.00
Welded Steel Pipe (10" diameter)	1,520	LF	$27.50	$41,800.00
Miscellaneous Valves and Fittings	1	LS	$20,000.00	$22,000.00
Welded Steel Pipe (8" diameter)	2,480	LF	$22.00	$54,560.00
Miscellaneous Valves and Fittings	1	LS	$20,000.00	$22,000.00
Subtotal				**$475,992.00**
3. Concrete				
Cast in Place Slab	150	CY	$495.00	$74,250.00
Cast in Place Walls	100	CY	$495.00	$49,500.00
Cast in Place Cover Slab	75	CY	$715.00	$53,625.00
Miscellaneous Metals	1	LS	$11,000.00	$11,000.00
Subtotal				**$188,375.00**
4. Architectural				
Protective Coatings	1,200	SF	$2.75	$3,300.00
Hardware (Doors and Windows)	1	LS	$5,500.00	$5,500.00
Subtotal				**$8,800.00**
5. Equipment				
Stripper Towers (12' diameter)	2	EA	$180,000.00	$360,000.00
Feed Pumps	2	EA	$55,000.00	$110,000.00
Subtotal				**$470,000.00**
6. Electrical				
Generator Capacity	1	LS	$50,000.00	$50,000.00
Miscellaneous Work	1	LS	5%	$60,208.35
Subtotal				**$110,208.35**
7. Instrumentation				
Miscellaneous Work	1	LS	3%	$36,125.01
Subtotal				**$36,125.01**
8. Plumbing				
Miscellaneous Work	1	LS	3%	$36,125.01
Subtotal				

Table 11-2
Cost Estimate for Selected Remedy
Florida Petroleum Reprocessors
Davie, Florida

Capital Cost for Remedy Component 1 (Pump and Treat with Air Stripper Towers)
Two (2) 12'-diameter air stripping towers; feed pumps; 20", 16", and 14" welded steel piping with miscellaneous valves and fittings; 12", 10", and 8" welded steel piping with miscellaneous valves and fittings; concrete; and Level D.

Description	Quantity	Unit	Unit Cost	Cost
9. General				
Contractor's OH&P	1	LS	20%	$260,110.27
Subtotal				**$260,110.27**
TOTAL				**$1,336,625.37**
Design Cost (6%)				$80,197.52
Contingency (10%)				$133,662.54
GRAND TOTAL CAPITAL COST				**$1,550,485.43**
Repair and Replacement (CC * 2%)	1	LS	2%	$31,009.71
Power Cost @ $0.05/KWH	1		$55,000.00	$55,000.00
TOTAL O&M COST				**$86,009.71**

NOTES:
Electrical Misc. Work = 5% of the subtotal costs for Items 1, 2, 3, 4, 5 and Generator Cap.
Instrumentation Misc. Work = 3% of the subtotal costs for Items 1, 2, 3, 4, 5 and Generator Cap.
Plumbing Misc. Work = 5% of the subtotal costs for Items 1, 2, 3, 4, 5 and Generator Cap.
Contractor's Overhead and Profit = 20% of the subtotal costs for Items 1, 2, 3, 4, 5, 6, 7, and 8.
Repair and Replacement = 2% of the Grand Total for Capital Cost.

Table 11-2
Cost Estimate for Selected Remedy
Florida Petroleum Reprocessors
Davie, Florida

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Summary of Present Worth Analysis (Pump &Treat with Stripping Towers) plus O&M

Year	Capital Cost	O&M Cost	Total Annual Outlays	Middle of Year Discount Factors	Present Worth
2001	$1,550,485.43	$0.00	$1,550,485	0.967	$1,499,319.41
2002	$0	$86,009.71	$86,010	0.903	$77,666.77
2003	$0	$86,009.71	$86,010	0.844	$72,592.20
2004	$0	$86,009.71	$86,010	0.789	$67,861.66
2005	$0	$101,009.71	$101,010	0.738	$74,545.17
2006	$0	$86,009.71	$86,010	0.689	$59,260.69
2007	$0	$86,009.71	$86,010	0.644	$55,390.25
2008	$0	$86,009.71	$86,010	0.602	$51,777.85
2009	$0	$86,009.71	$86,010	0.563	$48,423.47
2010	$0	$101,009.71	$101,010	0.526	$53,131.11
2011	$0	$86,009.71	$86,010	0.491	$42,230.77
2012	$0	$86,009.71	$86,010	0.459	$39,478.46
2013	$0	$86,009.71	$86,010	0.429	$36,898.17
2014	$0	$86,009.71	$86,010	0.401	$34,489.89
2015	$0	$101,009.71	$101,010	0.375	$37,878.64
Totals	**$1,550,485**	**$1,249,136**	**$2,799,621**		**$2,250,944.49**
Notes:	O&M Cost increase $15,000 at 2005, 2010, and 2015 for 5-year review cost. Assume 7% Discount Rate, 15 years.				

Table 11-2
Cost Estimate for Selected Remedy
Florida Petroleum Reprocessors
Davie, Florida

Capital Cost for Remedy Component 2 (MNA)
Ten (10) wells, 2" PVC casing, 140' depth, mud rotary, 10' screen, Level D

Description	Quantity	Unit	Unit Cost	Cost
1. Mobilization	1	LS	$1,250.00	$1,250.00
2. Monitoring Well Installation				
4" Mud Rotary Drilling	1,400	LF	$24.00	$33,600.00
2" PVC Casing	1,260	LF	$7.00	$8,820.00
2" PVC Screen	140	LF	$10.00	$1,400.00
2" S/S Well Plugs	10	EA	$14.00	$140.00
Split Spoon Samples	280	EA	$36.00	$10,080.00
Drums	75	EA	$50.00	$3,750.00
Drum Disposal	75	EA	$125.00	$9,375.00
Sand Pack	140	LF	$8.00	$1,120.00
Bentonite Seal	10	EA	$28.00	$280.00
Grout	1,260	LF	$1.50	$1,890.00
Locking Cover	10	EA	$250.00	$2,500.00
Conc. Cover Posts	10	EA	$250.00	$2,500.00
Well Development	10	EA	$350.00	$3,500.00
Move/Set-Up at Wells	10	EA	$300.00	$3,000.00
3. Demobilization	1	LS	$750.00	$750.00
Subtotal				**$83,955.00**
Design Cost (6%)				$5,037.30
Contingency (10%)				$8,395.50
TOTAL COST				**$97,387.80**

Estimate of One Monitoring Event (MNA)

Task	Units	Unit of Measure	Unit Price	Extended Price
Labor (2p/10 days x 10 hrs/day)	200	HR	$75.00	$15,000.00
Other Costs				
Sample Supplies ($100/well)	1	EA	$4,000.00	$4,000.00
Travel Costs (Lodging and Per Diem)	16	EA	$125.00	$2,000.00
Analysis Costs (40 wells x 1.1 ea)	44	EA	$350.00	$154,000.00
Subtotal				**$36,400.00**
Contingency (10%)				$3,640.00
Project Management (8%)				$3,000.00
Total Cost				**$43,040.00**

Table 11-2
Cost Estimate for Selected Remedy
Florida Petroleum Reprocessors
Davie, Florida

Summary of Present Worth Analysis (MNA)

Year	Capital Cost	Annual Monitoring	Total Annual Outlays	Middle of Year Discount Factors	Present Worth
2001	$97,892	$172,160	$270,052	0.967	$261,140.28
2002	$0	$86,080	$86,080	0.903	$77,730.24
2003	$0	$86,080	$86,080	0.844	$72,651.52
2004	$0	$43,040	$43,040	0.789	$33,958.56
2005	$0	$58,040	$58,040	0.738	$42,833.52
2006	$0	$43,040	$43,040	0.689	$29,654.56
2007	$0	$43,040	$43,040	0.644	$27,717.76
2008	$0	$43,040	$43,040	0.602	$25,910.08
2009	$0	$43,040	$43,040	0.563	$24,231.52
2010	$0	$58,040	$58,040	0.526	$30,529.04
2011	$0	$43,040	$43,040	0.491	$21,132.64
2012	$0	$43,040	$43,040	0.459	$19,755.36
2013	$0	$43,040	$43,040	0.429	$18,464.16
2014	$0	$43,040	$43,040	0.401	$17,259.04
2015	$0	$58,040	$58,040	0.375	$21,765.00
Totals	**$97,892**	**$905,800**	**$1,003,692**		**$724,733.28**

Note: O&M Cost increase of $15,000 at 2005, 2010, and 2015 for 5-year review cost. Assume 7% Discount Rate, 15 years.

Table 11-2
Cost Estimate for Selected Remedy
Florida Petroleum Reprocessors
Davie, Florida

Capital Cost for Remedy Component 3 (Source Area Pump and Treat with Air Stripper Towers)
Two extraction wells, one 12'-diameter air stripping tower with vapor carbon, on-site infiltration PVC piping with miscellaneous fittings, concrete, and Level C.

Description	Quantity	Unit	Unit Cost	Cost
1. Site Work				
Clearing and Grubbing	280	HR	$30.03	$8,408.00
Fencing	1,100	LF	$6.25	$6,869.50
Sediment Control Fencing				
3-Dim. Poly	500	SF	$1.43	$716.00
Straw Bales	500	EA	$3.07	$1,537.00
Subtotal				**$17,530.50**
2. Sampling and Analysis				
Water Samples:				
Sampling Supplies	1	LS	$3,500.00	$3,500.00
Techs	100	EA	$50.00	$5,000.00
Sample Shipping	10	EA	$187.50	$1,875.00
Water Analyses:				
Chem. Oxy. Demand (COD)	15	EA	$20.00	$300.00
Conductivity	15	EA	$7.00	$105.00
Dissolved Oxygen	15	EA	$10.00	$150.00
Total Hardness	15	EA	$15.00	$225.00
Tot. Metals (6010)	15	EA	$205.00	$3,075.00
Temperature	15	EA	$5.00	$75.00
Ion Chromatography	15	EA	$156.00	$2,340.00
Semivolatile Organics	15	EA	$350.00	$5,250.00
Volatile Solids	15	EA	$10.00	$150.00
Total Organic Hal.	15	EA	$85.00	$1,275.00
Subtotal				**$23,320.00**
3. PVC Extraction Wells - 6"-Dia.				
Mobilization	1	LS	$1,720.00	$1,720.00
Extraction Well Installations:				$0.00
12" Water Well Hole	160	LF	$24.75	$3,960.00
6" PVC Casing	140	LF	$20.31	$2,843.40
6" PVC Screen	20	LF	$25.30	$506.00
Bentonite Chips - Med. 1/4"	25	CF	$45.24	$1,131.00
Bentonite Grout - 3 lbs./gal.	25	CF	$47.88	$1,197.00
Sand Pack	10	CF	$42.90	$429.00
6" Solid Plugs - PVC	2	EA	$66.50	$133.00
6" Alum. Lock Cap	2	EA	$72.00	$144.00
Manhole Ring and Cover	2	EA	$131.50	$263.00
Precast Manhole	2	EA	$290.00	$580.00
MH Electrical	2	EA	$290.00	$580.00
15-135 gph Submersible Pump	2	EA	$2,485.00	$4,970.00
Develop Wells	2	HR	$180.50	$361.00
Pump Test Well	2	HR	$200.00	$400.00
Decontamination Time	2	HR	$57.50	$115.00
Standby Time	2	HR	$57.50	$115.00
Samples	20	EA	$57.35	$1,147.00
Level C Protection	10	HR	$34.40	$344.00

Capital Cost for Remedy Component 3 (Source Area Pump and Treat with Air Stripper Towers)
Two extraction wells, one 12'-diameter air stripping tower with vapor carbon, on-site infiltration PVC piping with miscellaneous fittings, concrete, and Level C.

Description	Quantity	Unit	Unit Cost	Cost
Subtotal				**$20,938.40**
4. On-Site Infiltration System				
Trench ½ CY Hyd. Excav.	2	HR	$43.50	$87.00
Trench Backfill w/ Frt. End Loader	2	HR	$29.50	$59.00
Compaction with Mechanical Tamper	2	HR	$39.00	$78.00
Gravel	10	CY	$24.30	$243.00
6" Diameter Perforated PVC Pipe	100	LF	$19.27	$1,927.00
Subtotal				**$2,394.00**
5. Recovery/Disposal Conduits				
Recovery Conduits - 6" Wells:				
4" Dia. PVC Sch. 40 Pipe (Rev)	100	LF	$2.50	$250.00
4" Dia. PVC 90 deg. Elbow (Rev)	5	EA	$31.40	$157.00
4" Dia. PVC 45 deg. Elbow (Rev)	5	EA	$30.60	$153.00
4" Dia. PVC Tee (Rev)	5	EA	$41.00	$205.00
4" Dia. PVC Coupling (Rev)	5	EA	$28.20	$141.00
Disposal Conduits - 6" Wells				
4" Dia. PVC Sch. 40 Pipe (Disp)	100	LF	$2.50	$250.00
4" Dia. PVC 90 deg. Elbow (Disp)	5	EA	$31.40	$157.00
4" Dia. PVC 45 deg. Elbow (Disp)	5	EA	$30.60	$153.00
4" Dia. PVC Tee (Disp)	5	EA	$41.00	$205.00
4" Dia. PVC Coupling (Disp)	5	EA	$28.20	$141.00
Electrical Conduits				
2" Dia. Sch. 40 PVC Pipe	200	LF	$1.05	$209.00
2" Dia. PVC 90 deg. Elbow	5	EA	$9.40	$47.00
2" Dia. PVC 45 deg. Elbow	5	EA	$9.60	$48.00
2" Dia. PVC Coupling	5	EA	$9.20	$46.00
Outside Electrician	25	HR	$32.04	$801.00
Subtotal				**$2,963.00**
6. Equipment				
Stripper Tower (12' Dia.)	1	EA	$180,000.0	$180,000.00
Feed Pump	1	EA	$55,000.00	$55,000.00
Subtotal				**$235,000.00**
7. Concrete				
Cast in Place Slab	75	CY	$495.00	$37,125.00
Cast in Place Walls	50	CY	$495.00	$24,750.00
Cast in Place Cover Slab	40	CY	$715.00	$28,600.00
Misc. Metals	1	LS	$11,000.00	$11,000.00
Subtotal				**$101,475.00**
8. Architectural				
Protective Coatings	600	SF	$2.75	$1,650.00
Hardware (Doors and Windows)	1	LS	$5,500.00	$5,500.00
Subtotal				**$7,150.00**
9. Instrumentation				

Table 11-2
Cost Estimate for Selected Remedy
Florida Petroleum Reprocessors
Davie, Florida

Capital Cost for Remedy Component 3 (Source Area Pump and Treat with Air Stripper Towers)
Two extraction wells, one 12'-diameter air stripping tower with vapor carbon, on-site infiltration PVC piping with miscellaneous fittings, concrete, and Level C.

Description	Quantity	Unit	Unit Cost	Cost
Miscellaneous Work	1	LS	3%	$8,364.78
Subtotal				**$8,364.78**
10. Plumbing				
Miscellaneous Work	1	LS	3%	$8,364.78
Subtotal				**$8,364.78**
11. General				
Contractor's OH&P	1	LS	20%	$85,500.09
Subtotal				**$85,500.09**
TOTAL				**$513,000.54**
Design Cost (6%)				$30,780.03
Contingency (10%)				$51,300.05
GRAND TOTAL CAPITAL COST				**$595,080.63**
12. O&M Startup (30 Days)				
Labor	490	MH	$32.25	$15,804.00
Travel	18	EA	$300.00	$5,400.00
Per Diem	45	DY	$75.00	$3,375.00
Power Cost	75,000	KWH	$0.08	$6,000.00
Partial Sample Analysis	25	EA	$250.00	$6,250.00
Sample Shipping	5	EA	$125.00	$625.00
Subtotal O&M Cost				**$37,454.00**
Repair and Replacement (CC * 2%)	1	LS	2%	$11,901.61
Power Cost @ $0.05/KWH	1		$55,000.00	$55,000.00
TOTAL O&M COST				**$66,901.61**

NOTES:
Electrical Misc. Work = 3% of the subtotal costs for Items 1, 2, 3, 4, 5, and 6.
Plumbing Misc. Work = 3% of the subtotal costs for Items 1, 2, 3, 4, 5, and 6.
Contractor's Overhead and Profit = 20% of the subtotal costs for Items 1 through 10.
Repair and Replacement = 2% of the Grand Total for Capital Cost.

Table 11-2
Cost Estimate for Selected Remedy
Florida Petroleum Reprocessors
Davie, Florida

Summary of Present Worth Analysis (Source Area Pump and Treat with Stripper Tower) plus O&M

Year	Capital Cost	O&M Cost	Total Annual Outlays	Middle of Year Discount Factors	Present Worth
2001	$595,080.63	$37,454.00	$632,535	0.967	$611,660.99
2002	$0	$66,901.61	$66,902	0.903	$60,412.15
2003	$0	$66,901.61	$66,902	0.844	$56,464.96
2004	$0	$66,901.61	$66,902	0.789	$52,785.37
2005	$0	$81,901.61	$81,902	0.738	$60,443.39
2006	$0	$66,901.61	$66,902	0.689	$46,095.21
2007	$0	$66,901.61	$66,902	0.644	$43,084.64
2008	$0	$66,901.61	$66,902	0.602	$40,274.77
2009	$0	$66,901.61	$66,902	0.563	$37,665.61
2010	$0	$81,901.61	$81,902	0.526	$43,080.25
2011	$0	$66,901.61	$66,902	0.491	$32,848.69
2012	$0	$66,901.61	$66,902	0.459	$30,707.84
2013	$0	$66,901.61	$66,902	0.429	$28,700.79
2014	$0	$66,901.61	$66,902	0.401	$26,827.55
2015	$0	$81,901.61	$81,902	0.375	$30,713.10
Totals	**$595,081**	**$1,019,077**	**$1,614,157**		**$1,201,765.30**

Notes: O&M Cost increase $15,000 at 2005, 2010, and 2015 for 5-year review cost.
Assume 7% Discount Rate, 15 years.

12.0 STATUTORY DETERMINATIONS

This section of the ROD discusses how the selected remedy fulfills the statutory requirements of Section 121 of CERCLA with respect to protection of human health and the environment; compliance with ARARs; cost-effectiveness; utilization of permanent and alternative treatment solutions; and utilization of treatment for the reduction in toxicity, mobility, and volume.

12.1 Protection of Human Health and the Environment

The selected remedy for this Site satisfies the statutory requirement for protection of human health and the environment through treatment and engineering controls. The selected remedy includes the treatment of contaminated groundwater to reduce the long-term threat to the Biscayne aquifer posed by the mass of VOCs that have been released from the FPR facility and the FDOT I-595 secondary source area. Although no significant carcinogenic or noncarcinogenic risks from exposures to soil were estimated, cumulative carcinogenic and noncarcinogenic risks from the potential exposure to contaminated groundwater were 6×10^{-2} and 220, respectively. Implementation of this remedy will result in the long-term attainment of MCLs for groundwater and will result in a reduction of risk to within EPA's risk range of 1×10^{-4} to 1×10^{-6}.

EPA believes that the selected remedy provides a more reliable degree of protection of human health and welfare than Alternative GW4 as originally proposed. As discussed previously, Alternative GW4 would have required that additional design studies and sampling be conducted to determine criteria such as the nature, size, and location of the containment system. This would likely have extended the period of time for implementation of the remedy to treat the groundwater near and at the wellfield by one to two years. During this period of time, residents dependent on water provided by the Peele-Dixie Wellfield would continue to bear the risks associated with low water volume and pressure.

The selected remedy is expected to provide a higher degree of long-term protection of the Biscayne aquifer. There is concern that if a hydraulic containment system were implemented, regardless of the safeguards included, the potential exists that contaminants might bypass the containment system and enter the wellfield from the south. Due to the interactive nature of the pumping of the wellfield and its effect on the movement of contaminated groundwater south of the wellfield, as well as the technical feasibility to pump, test and store and millions of gallons of water before it enters the distribution system, there exists the potential for the distribution of contaminated drinking water. Pumping and treating all of the groundwater collected from the southern part of the wellfield ensures that no contaminants will enter the drinking water supply from the identified groundwater sources.

12.2 Compliance with ARARs

Implementation of the selected remedy will comply with all federal and state contaminant-specific, action-specific, and location-specific ARARs. Contaminant-specific ARARs attained will primarily include federal and state drinking water and air emission standards and hazardous waste regulations. Action specific requirements that will be complied with primarily include federal and state discharge requirements and hazardous waste regulations. Finally, location-specific requirements that will be addressed include federal and state hazardous waste regulations and discharge standards. A summary of ARARs to be met through the implementation of the selected remedy is provided in Table 11-1.

12.3 Cost-Effectiveness

EPA has determined that the selected remedy is cost-effective and that the overall effectiveness of the remedy is proportional to the overall cost of the remedy. The cost-effectiveness of the selected remedy was evaluated by comparing the overall effectiveness of the remedy (i.e., long-term effectiveness and permanence; reduction in toxicity, mobility, and volume; and short-tem effectiveness) with the overall cost of the remedy. More than one remedial alternative may be considered cost-effective, but CERCLA does not mandate that the most cost-effective or least expensive remedy be selected.

A review of the expected performance of the selected remedy indicates that the remedy will be one of the most effective in reducing contaminant levels in the Biscayne aquifer within a reasonable period of time. It will also result in the permanent reduction of the toxicity, mobility, and volume of contaminants. While the selected remedy may present the potential for an increase in the short-term risks, such risks can be addressed through proper engineering controls and safety measures. In addition, the selected remedy will be the most effective at timely addressing the use restrictions associated with the Peele-Dixie Wellfield.

EPA believes that the total present worth cost of the selected remedy of $4,200,000 is proportional to the overall effectiveness of the selected remedy. While Alternative GW3 may provide a comparable level of effectiveness in addressing the cleanup of the large aqueous plume, it would not be nearly as effective in addressing the potential threat of the northerly migration of contaminants in the Biscayne aquifer towards the Peele-Dixie Wellfield. Although the cost of the selected remedy is approximately 50 percent higher than the cost of GW3, EPA has assigned a high degree of importance to the Peele-Dixie Wellfield (See CERCLA § 118, 42 U.S.C. § 9618). Not only is it a valuable drinking water resource, but the wellfield also assists the City of Fort Lauderdale in operating and managing its municipal water supply services in a safe and efficient manner. The selected remedy represents a more aggressive and protective groundwater treatment option and will be the most effective means to ensure the unrestricted use of the wellfield in the shortest period of time.

EPA also believes that the selected remedy will be more cost-effective in the short-term and long-term than Alternative GW4 as originally proposed. In the short-term, Alternative GW4 would have required remedial design studies that would have likely cost $300,000 to $500,000 to provide the necessary design criteria. It is also anticipated that the long-term operation and maintenance cost of Alternative GW4 could be higher than that estimated for the selected remedy. If concerns regarding the effectiveness of the GW4 hydraulic containment system were validated through operation of the system, additional costs would be incurred as a result of modifications to the system to improve the effectiveness of the barrier. It is anticipated that the cost associated with the design and construction of the selected remedy are more reliably estimated due to the availability of more definitive design criteria.

12.4 Permanent and Alternative Treatment Solutions

The selected remedy uses permanent solutions and alternative treatment solutions to the maximum extent practicable. The selected remedy will provide the greatest degree of long-term effectiveness and permanence. While the selected remedy does rely on MNA to address much of the groundwater plume, it does incorporate the pumping and treating of groundwater at the wellfield to permanently reduce groundwater contaminants that threaten both the Biscayne aquifer and the wellfield to within MCLs within the shortest period of time possible. It also includes active remediation of the groundwater at the FPR facility to reduce groundwater contaminant levels.

12.5 Preference for Treatment as a Principal Element

In addition to the four statutory mandates previously discussed, the NCP includes a preference for treatment for the selected remedy in addressing the principal threat at the Site. Among the alternatives considered, the selected remedy incorporates the highest degree of treatment. The selected remedy will not only result in the treatment of the contaminated groundwater through MNA and groundwater treatment at the facility, but will also actively collect and treat through air stripping the groundwater contaminants in the northern portion of the plume that threaten Biscayne aquifer and Peele-Dixie Wellfield.

13.0 DOCUMENTATION OF SIGNIFICANT CHANGES

Comments received during the public comment period for the Proposed Plan issued in June 2000 prompted EPA to change the preferred remedial alternative identified in the Proposed Plan. EPA has discussed these public comments with all of the PRPs and Site stakeholders.

Fundamentally, the selected remedy is consistent with the primary objectives of the GW4 preferred alternative identified in the Proposed Plan. It still addresses contaminants in the groundwater through treatment and MNA and also provides for the protection of the southern portion of the Peele-Dixie Wellfield. The selected remedy was modified to provide for a more expeditious, reliable, and cost-effective means for collecting and treating the contaminated groundwater that will also allow the City to resume complete use of the wellfield on an expedited basis.

During the development of the FS Addendum, several meetings were held with the stakeholders (including the SW Coalition of Civic Associations, City of Fort Lauderdale, Broward County, federal and state agencies, and the PRPs). During the development of the alternatives for the FS Addendum, use of the infrastructure of the southern portion of the Peele-Dixie Wellfield as a groundwater recovery system coupled with the installation of an air stripping system had been proposed as a remedial alternative to address the threat posed by the contamination in the northern part of the plume. Although it was determined to be a viable alternative, it had been ruled out due to the City's desire to avoid being involved with the long-term operation of an extensive groundwater pump and treat system. Also, in deference to state and federal policy considerations, EPA favored developing a remedial alternative that would address the source of contamination, rather than relying on treatment at the wellhead as the sole remedy.

However, comments received during the public comment period and new information received after the comment period caused EPA to reevaluate its selection of a remedy for this Site. Shortly after the close of the public comment period the City of Fort Lauderdale completed the development of its Master Plan for its future water needs. The City realized that although it had capacity at its Fiveash Wellfield to supply its raw water needs, the system's existing infrastructure is insufficient to transfer the water from the Five Ash Plant to customers in the southern and western portions of the City and other neighboring communities outside the City limits. As a result, without at least $10,000,000 in capital improvements to the City's water delivery infrastructure, the plan concludes that the City needs the capability to now withdraw a minimum of 10 MDG from the entire Peele-Dixie Wellfield on a daily average, with a one-day maximum of 15 mgd.

Because of the Master Plan data, the City agreed that the most expedient and reliable way to regain the historical use of the water in the Peele-Dixie Wellfield would be to agree to pump and treat the contaminated groundwater at the wellfield, as opposed to pumping and treating at the FPR facility and attempting to prevent the contaminants from entering the wellfield through the construction of a hydraulic containment system.

In addition to the new information provided by the City, some of the public commenters suggested that the groundwater could be treated and the Peele-Dixie Wellfield could be protected more reliably and cost-effectively through the treatment of contaminants collected via the production wells in the southern part of the wellfield. The commenters contended that a barrier would not be as effective, since contaminants could possibly migrate around or through the barrier.

Therefore, in developing the selected remedy, EPA chose to modify the preferred alternative GW4. While the scope and cost was significantly modified, the selected remedy is fundamentally the same as the preferred alternative in that the groundwater at the facility will be addressed through pumping and treating, as necessary; the large aqueous plume will be treated through MNA; and the wellfield will be protected through the pumping and treating of groundwater.

Although the air stripping system represents a significant change in one component of the Site remedy, EPA believes that since this remedial technology was discussed at public meetings on several prior occasions, it is a reasonable outgrowth of the process and could have been reasonably anticipated by the public based on their extensive involvement and representation throughout the process. As discussed previously, EPA was very aggressive in actively involving representatives of the public as stakeholders throughout this process. Specifically, EPA worked closely with the Southwest Coalition of Civic Associations during the development of the FS Addendum, the Proposed Plan, the review of public comments, and the development of the selected remedy. The Coalition represents approximately 44,000 homes in the affected area. Likewise, EPA worked closely with other public entities including the State, Broward County, and the City of Fort Lauderdale. Finally, EPA worked closely with the PRPs throughout this process. Based on the information that was discussed and reviewed with these stakeholders during the FS and Proposed Plan processes, and in consideration of the Proposed Plan comments, EPA believes that this change is a logical outgrowth of the process and thereby could be reasonably anticipated by the public (see 40 CFR § 300.430(f)(3)(ii)(A)).

Furthermore, EPA noted in the description of alternative GW4 in the Proposed Plan that there was some uncertainty regarding the ultimate form in which the goal of wellfield protection would be achieved. The Plan noted that other mechanisms for the protection of the wellfield would be evaluated during the Remedial Design process. The Plan acknowledged that a hydraulic barrier was a demonstrated technology, but there may be other wellfield protection measures that could be implemented to offer a superior degree of protection, performance, or cost-effectiveness than a hydraulic barrier.

Therefore, because the possibility of different wellfield protection measures were acknowledged in the Proposed Plan, EPA believes that this change has been documented in this ROD in accordance with 40 C.F.R. § 300.340 (f)(3)(ii)(A), and there is no need for additional public notice and comment on the change.

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APPENDIX A

RESPONSE TO COMMENTS

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List of Acronyms

AGM	ARCADIS Geraghty & Miller
BB&L	Blasland Bouck & Lee
BCDNRP	Broward County Department of Natural Resource Protection
CERP	Comprehensive Everglades Restoration Program
CFR	Code of Federal Regulations
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
DNAPL	dense nonaqueous-phase liquid
EPA	U.S. Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Resources
FDOT	Florida Department of Transportation
FPR	Florida Petroleum Reprocessors
FS	feasibility study
μg/L	micrograms per liter
MCL	maximum contaminant level
MNA	monitored natural attenuation
NCP	National Contingency Plan
PCE	perchloroethene
ppb	parts per billion
PRP	potentially responsible party
RI	remedial investigation
ROD	Record of Decision
SFWMP	South Florida Water Management District
TCE	trichloroethene
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geologic Survey
VOC	volatile organic compound
WES	Waterways Experimental Station

RESPONSIVENESS SUMMARY
FLORIDA PETROLEUM REPROCESSORS SUPERFUND SITE
DAVIE, FLORIDA

1.0 Introduction

As part of its public participation responsibilities set forth in Title 40 Code of Federal Regulations (CFR) Section 300.430, the U.S. Environmental Protection Agency (EPA) is required to provide the public with an opportunity to comment on the Agency's Proposed Plan and supporting analysis and information. EPA is then required to provide a written summary and response to significant comments, criticisms, and new relevant information submitted to the Agency during the comment period.

The following is a Responsiveness Summary that addresses the comments received by EPA during the June 20 through August 21, 2000, public comment period on EPA's Proposed Plan for Operable Unit 1 of the Florida Petroleum Reprocessors Superfund Site (FPR Site) in Davie, Florida. Although originally scheduled to end on July 21, EPA extended the public comment period an additional 30 days to August 21, 2000. EPA held a public meeting on June 27, 2000, at the Sunview Park Recreational Building in Fort Lauderdale, Florida to discuss the Proposed Plan with the public and to receive their comments.

In addition to comments received at the public meeting, EPA received written comments during the public comment period. EPA's responses to significant comments received during the public comment period are included in this Responsiveness Summary. All comments summarized in this document were considered by EPA in preparing the Record of Decision (ROD).

Comments were received from members of the community, the State of Florida Department of Environmental Protection (FDEP) and South Florida Water Management District (SFWMD), Broward County Department of Natural Resource Protection (BCDNRP), the city of Fort Lauderdale, and representatives of the potentially responsible parties (PRPs) for the site. Written comments were submitted by numerous individuals and on behalf of the Broadview Park Civic Association, Greater Flamingo Park Civic Association, River Run Civic Association, and the South West Coalition of Civic Associations. Comments were submitted on behalf of the PRPs by Holland and Knight LLP and Golder Associates, legal and technical representatives of the FPR Steering Committee ("PRP Group"). Comments also were submitted by two governmental PRPs, including the Florida Department of Transportation (FDOT) and Miami-Dade County.

Due to the source and nature of comments received, comment summaries and EPA responses will be divided into three separate categories including: Community Comments, State and Local Government Comments, and PRP Comments. Since the majority of comments were received in a written format and generally reiterate comments received during the public meeting, the comment summaries and responses will first address the written comments. Verbal comments not addressed by the written comments will then be addressed. Multiple comments on the same topic will be combined into one comment and response, and if commenters from different groups submit the same comments, only one summary and response will be provided, with cross-references to the other category. Finally, while this document summarizes all of the significant comments received, due the volume and in-depth nature of many of the PRP comments, the reader should consult the actual comments maintained in the Administrative Record for a more detailed account of the comments.

2.0 Community Comments

2.1 Remedy Support

EPA received comments from numerous residents and community organizations voicing strong support for EPA's adoption of Alternative GW4, which incorporates source remediation, wellfield protection, and monitored natural attenuation (MNA), as the selected remedy for the ROD. The common theme cited among all of the comments supporting GW4 was the importance for the protection of the Peele-Dixie Wellfield and restoration of the unrestricted pumping of the wellfield as soon as possible. Significant concern was expressed that without the full use of the Peele-Dixie Wellfield, the Fort Lauderdale water supply system will not be able to meet its future water needs.

EPA Response: *EPA agreed with the community comments regarding the importance and protection of the Peele-Dixie Wellfield. Community concern was an important factor considered by EPA in the selection of Alternative GW4.*

2.2 Impacts to Communities and Water Resources South of the FPR Site

Four community residents who attended the proposed plan meeting in June 2000 expressed concern over how the southward migration of the plume might impact the water supply for the City of Hollywood and other communities expanding to the south of the FPR Site. One asked how the Everglades restoration also might be impacted.

EPA Response: *EPA stressed to those in attendance at the Proposed Plan meeting that its responsibility to Davie residents is to protect existing water resources as well as to restore those resources that have been impacted by contamination. One purpose of the selected remedy is to keep the contamination from migrating. Once the groundwater is restored for use, the EPA said it will be up to local municipalities how they choose to use the available water resources.*

2.3 Use of the Peele-Dixie Wellfield

Three community residents who attended the proposed plan meeting in June 2000 expressed concern about how quickly the Peele-Dixie Wellfield can begin pumping to its maximum level. One said that the calculations for the time that pumping can resume to its maximum rate is not adequate. Another resident wanted to know if the proposed remedy did not work, what recourse EPA had.

EPA Response: *Comments such as these contributed to EPA's modification of a portion of Alternative GW4 to include pumping and treating of groundwater at the wellfield. Although EPA believes that the groundwater containment system could have been built and operated in a reliable fashion, it is true that the most reliable method for ensuring that customers did not received any contaminated groundwater would be to treat the water at the wellhead.*

2.4 Involvement of Other Agencies in the Process

One resident who attended the Proposed Plan meeting in June 2000 expressed concern about the absence of a representative of the Florida Department of Toxicology (sic) who had been active in the early investigation of the FPR Site. He said he thought that a 90-page report issued by the department had been totally ignored, saying that the report suggested that a barrier alternative should be used as a last resort.

EPA Response: *The EPA has allowed the Florida Department of Health and Rehabilitative Services to review the Proposed Plan. Their suggestions and recommendations have not been contrary to EPA's proposed alternative for the FPR Site. The department was invited to the Proposed Plan meeting to comment on the Proposed Plan.*

3.0 State and Local Government Comments

3.1 FDEP Comments

The FDEP relayed to EPA its support for the selection of Alternative GW4. It felt that this alternative represented a good balance among alternatives and remedy components. FDEP felt that the remedy was not too excessive in requiring the active remediation of areas that were not likely to pose immediate threats in the future, but incorporated a more aggressive response in the treatment of source areas and the protection of the Peele-Dixie Wellfield.

EPA Response: *EPA agreed with FDEP's comments in support of Alternative GW4. EPA believes this alternative represents the best balance of trade-offs among the alternatives and provides a measured response that takes into account the differences in potential risk posed by different portions of the facility and groundwater plume.*

3.2 South Florida Water Management District Comments

The SFWMD voiced its strong support in the selection of Alternative GW4. The District contended that the remediation of source materials and groundwater at the FPR facility and the secondary source area, and a barrier for the protection of the Peele-Dixie Wellfield are critical components of the remedy. The SFWMD stated that the loss of the southern portion of the wellfield has impacted the city of Fort Lauderdale's ability to reliably provide drinking water and that the barrier will provide a mechanism for the city to more rapidly return the wellfield to historical pumping levels.

A related issued noted by the District is that it is working with the USACE on the Comprehensive Everglades Restoration Program (CERP), which is intended, in part, to enhance the flow of water to the Everglades, while continuing to meet the urban and agricultural needs of South Florida. The District believes that any efforts by EPA to aid in the restoration of water supplies will help to implement the CERP.

EPA Response: *EPA agreed with the SFWMD in the importance of protection of the Biscayne aquifer as a drinking water resource and the restoration of the Peele-Dixie Wellfield to historical pumping levels as soon as possible. EPA agreed with the District in the appropriateness of Alternative GW4 for the remediation of soil and groundwater and the protection of the Peele-Dixie Wellfield.*

3.3 Broward County Board of Commissioners

EPA received comments from the Broward County Board of Commissioners fully supporting the selection of Alternative GW4. The Commission stated that it concurs with and strongly supports EPA's recommendation for the selection of Alternative GW4 as the option that provides the fastest method for cleaning up the groundwater and allowing the Peele-Dixie Wellfield to resume pumping at historical levels.

EPA Response: *EPA appreciates the Commission's support and took into consideration the Commission's comments in the selection of Alternative GW4.*

3.4 City of Fort Lauderdale Comments

The city of Fort Lauderdale provided comments to EPA on the Proposed Plan in the form of a resolution. The city of Fort Lauderdale Commission passed a resolution on July 18, 2000, that formally supports the adoption of Alternative GW4 for the remediation of the FPR Superfund Site. The Commission believes that this remedy is needed to protect and provide for the eventual full use of the valuable groundwater resource known as the Peele-Dixie Wellfield.

EPA Response: *EPA appreciates the city's support for the adoption of Alternative GW4 through the formal issuance of a resolution. The city's comments were taken into consideration in the evaluation and selection of a remedy for the FPR Site.*

4.0 PRP Comments

EPA received numerous comments from the PRP Steering Committee ("the Group"), Golder Associates on behalf of the Group, Miami-Dade County, and FDOT. Although some of the comments address the same topic, many of the comments are specific to the individual PRPs. As a result, the comments and responses will be organized by PRP. Where multiple comments are provided that address a common issue, the multiple comments will be noted, but only one response provided.

4.1 The PRP Group

The PRP Group submitted more than 50 pages of comments on the June 2000 Proposed Plan, and by reference included the more than 100 pages of comments submitted on the June 1998 Proposed Plan. This extensive volume of comments relates primarily to two major issues, including the potential impacts of releases from the FPR facility on the Peele-Dixie Wellfield and groundwater modeling predictions relating to groundwater movement and fate and transport and the hydraulic connection of the FPR facility to the wellfield. A summary of significant comments that relate to these issues follows. Other nontechnical comments that relate primarily to legal and administrative issues are addressed as well.

4.1.1 Groundwater Model

EPA has received numerous comments from the PRPs and their three consultants, Geraghty & Miller, Blasland Bouck & Lee (BB&L), and Golder Associates, regarding the groundwater modeling efforts performed by EPA and the USACE Waterways Experimental Station (WES). Due to the technical nature of the topic, the comments are extensive and very detailed. While the following captures the significant issues present in the comments, the actual comments received are available for review in the Administrative Record for this Site.

The PRPs have repeatedly commented that the Corps' groundwater modeling efforts have not used the proper parameters and assumptions to portray accurately the environmental and hydrogeologic conditions specific to the site. As a result, the PRPs contend that all of the groundwater modeling is not accurate and, therefore, the groundwater model cannot be used to make predictions reliably as to how contaminants migrated in the past or may migrate in the future in order to evaluate potential cleanup alternatives. Moreover, the PRPs contend that the model cannot be used to demonstrate a hydraulic connection between the FPR facility and the Peele-Dixie Wellfield. Finally, the PRPs suggest that EPA has excluded the Group from all involvement in the development and review of the model. The Group suggests that EPA has subverted the National Contingency Plan (NCP) public participation requirements by not allowing the Group to review the input parameters for the most recent groundwater modeling efforts.

EPA Response: *EPA disagrees with the PRPs' comments regarding the quality of the model and its usability. EPA also disagrees with the Group's comments that it has not been able to provide meaningful input into the model development. Before addressing more specific issues, however, it is important to clarify the original intent and goals of the model.*

The original intent of the groundwater modeling was to gather information that could be used to evaluate better the hydraulic connection of the FPR facility with the Peele-Dixie Wellfield and to aid the evaluation and design of various groundwater cleanup alternatives. It was never intended to serve as the basis for remedy selection. The basis for the remedy is derived directly from Sections 104 and 118 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the NCP. Pursuant to Section 104 of CERCLA, EPA is authorized to respond to the release or threat of release of hazardous substances, pollutants, or contaminants that may pose a threat to human health, welfare, or the environment. In Section 118 of CERCLA, Congress assigned a higher priority to releases that had contaminated public drinking water supplies or drinking water wells. Moreover, the NCP and preamble are clear that it is EPA's intent to restore drinking water resources that have been contaminated by releases of hazardous substances, pollutants, or contaminants to their beneficial use. In cases where the release has contaminated or potentially threatens a unique aquifer such as a Class I aquifer or a sole-source drinking water aquifer or a wellhead protection area, the Agency has assigned a higher priority to these areas and expects to restore these areas to their beneficial uses as rapidly as possible.

In the case of FPR, the remedy is based solely on the fact that a large release of hazardous substances from the FPR facility and a secondary source area have impacted a Class I, sole-source drinking water area. Based on this fact alone, EPA expects to restore the aquifer to its beneficial use as rapidly as possible. The facts that the release is adjacent to a municipal wellfield and wellhead protection area, that the wellfield was contaminated, and that local residents received contaminated drinking for up to a 2-year period establish the urgency for taking the action. Although EPA believes that the data clearly shows that the FPR facility is the primary source of the release, this is strictly a liability issue. The implementation of a groundwater restoration or containment remedy is not contingent on the demonstration of a former or future potential hydraulic connection or contaminant migration.

With regard to comments relating to the quality of the groundwater model, EPA knew that this would be an important issue with regard to liability and chose a nationally recognized center of expertise, the USACE WES, to develop the model. WES completed the work in 1998 and published a report that described the methodology, assumptions, input data, and results. From the beginning of this project, EPA adopted an "inclusive-policy" approach whereby EPA solicited comments from all interested parties, including representatives of federal, state, and local regulatory agencies, the city of Fort Lauderdale, the community, and PRPs, on various draft interim deliverables and the final modeling report. Several meetings were held to discuss the results, and the model was subsequently revised in 1998 to incorporate the peer review comments. The most recent work has involved the development of different remedial simulations *using the model developed in 1998. The results from the remedial simulations were included and used to develop the feasibility study (FS) addendum and are included in the Administrative Record.*

While comments from federal, state, and local agencies, and the community were generally supportive of the modeling results, the PRPs' comments were generally critical of model. These issues primarily relate to input parameters such as effective porosity and the model calibration. It is true that these issues have been greatly debated over the past 2 years. EPA has reviewed and discussed with the PRPs their comments and concerns, but this may simply be a case where technical experts disagree. Although the PRPs' technical comments have been formally addressed in detail, a brief response to the PRPs' significant comments regarding the groundwater model follows.

Numerical Modeling Facts

It is true that the root-mean-square (RMS) error for the snapshots, when taken individually, is larger than 10 percent of the individual ranges. It was never reported otherwise. One snapshot showed an error of 38 percent. However, for this snapshot, the RMS error was 0.27 foot, or about 3 inches. The mean error was 0.20 foot. The mean absolute error was 0.21 foot (2.5 inches). Therefore, virtually all the predictions were 0.2 foot too high. The head gradients and flow directions predicted by the model match those in the field very closely. In retrospect, the error measure chosen for this study (RMS error/observation range) is probably not the best measure of model performance for this site. Several of the other snapshots suffered from the same problem: generally too much or too little water. These uniform errors often may be attributed to slight errors in timing when heads are rising or falling or to the time averaging problem. Model results represent weekly or monthly averages of groundwater heads. These are compared with "instantaneous" measurements made in the field. These instantaneous measurements, particularly near the surface, are subject to influence by very recent rainfall and changes in pumping at the well field.

Much discussion is devoted to the apparent error at one point near the canal, observation well G-854. The errors originally reported at G-854 were very troubling. Model predictions were consistently low by about 2 feet. The U.S. Geological Survey (USGS) was contacted to verify the data. Upon investigation and re-leveling, the well datum was discovered to be in error by 1.95 feet, making the model predictions match observations very well. In fact, virtually all the errors for this observation point are now over-predictions. Thus, using Golder's reasoning, the model may be under-predicting the northward migration of the plume.

To verify the reasonableness of the model calibration, the flow model calibration was examined and generally commended by two third-party reviewers, including the Idaho National Engineer and Environmental Laboratory and the University of Waterloo.

Effective Porosity Facts

The entire debate of effective porosity stems from the fact that numerical models for groundwater flow and transport were not designed for highly heterogeneous media. This problem is being corrected slowly as new models emerge and old models are extended. In the meantime, we must use traditional modeling tools creatively to represent these heterogeneous systems. The Biscayne aquifer's behavior lies somewhere between a traditional porous continuum and a fractured medium. Drilling logs noted high primary and secondary porosities. Groundwater models are available that simulate flow and transport through single-porosity material, dual-porosity (mobile-immobile) material, or fractures. None of these approaches is suitable for representing preferential transport through the Biscayne without some model adjustments.

Two issues are being addressed with the transport model: (1) migration patterns and evaluation of the leading edge, and (2) remedial simulations. These require that two different parts of the pore space be represented. For the leading-edge estimations, the EPA's conceptual site model (CSM) proposes highly preferential flow through only a few pathways. For this simulation, the advective velocity should reflect the seepage speeds in those high-conductivity paths, not the bulk conductivity. For this assessment, the effective porosity used to compute seepage velocity may be only a fraction of the specific yield. For high Peclet number (ratio of advective speed to diffusive speed) transport, the medium "acts" more like a fractured system than a porous medium. For lower Peclet number transport, it behaves more like a porous medium. These same trends were also found in modeling done by Ii et al (1995). In their work, at very low velocities, the apparent effective porosity was nearly equal to the specific yield (10 percent). However, with large flows, the apparent effective porosity was 1/20th the specific yield (0.48 percent).

For the remedial simulations, the primary mechanism for contaminant removal is by natural attenuation. Therefore, the leading edge of the plume is less of a concern. The conservative approach would use a lower seepage velocity (higher effective porosity) to represent those contaminants in lower permeability material. These contaminants will be subject to less dilution and mixing. Thus, a value of 10 percent was chosen for the Biscayne aquifer for these simulations.

The extensive data review establishes a range for the specific yield. Again, specific yield is not the effective porosity required to simulate transport in a heterogeneous medium. Using the specific yield to estimate effective porosity assumes that the entire, inter-connected pore space participates equally in transporting constituents. This assumption may be poor in heterogeneous media and lead to grossly erroneous predictions of migration speeds. The ONLY way to measure the appropriate effective porosity coefficient is by large-scale tracer tests. The closest available study to a tracer test in this aquifer is the USGS evaluation of a brackish artesian well (Merritt, M. L., 1996, "Numerical simulation of a plume of brackish water in the Biscayne aquifer originating from a flowing artesian well, Dade County, Florida," WSP2464, USGS). Initial estimate of hydraulic conductivity was 5,000 feet per day. The effective porosity for transport was set to the specific yield for the Biscayne: about 0.2. But the salt water plume *moved much less than expected in this layer of the model. Rather than adjusting the effective porosity, the modelers decided to adjust their hydraulic conductivity by a factor of 6. Nearly the same breakthrough time would be achieved using an effective porosity of 0.2/6 or about 3.5 percent.*

Recent work by Chunmiao Zheng, the author of MT3D, further emphasizes the need for a multiple-porosity formulation. Zheng was attempting to model observed tracer movement at the MADE site, a highly heterogeneous alluvial deposit. He was unsuccessful using a single porosity model with effective porosity near the specific yield. Using a dual-porosity approach (mobile-immobile), he obtained a much better fit to the data. The fraction of the porosity that was declared "mobile" was about 1/7. Thus, the effective porosity for the mobile region was approximately 0.3/7 or about 4 percent.

Remedial Simulations

Golder rightly notes that the shallow zone contamination increases rapidly soon after the simulation begins. There is an apparent co-mingling of the two distinct plumes. They incorrectly attribute the appearance in the south to lateral migration of contaminants in the shallow zone. All of these observations are attributable to vertical interaction between the shallow and deep zones.

Vertical conductivities in the model were taken from the anisotropy ratios used in the SFWMD model of Broward County. Over the range of anisotropies tested, the anisotropy ratio did not appreciably affect the flow calibration and was retained. Recently, measured vertical gradients were examined more carefully. The model was slightly under-predicting the measured gradient and over-predicting the vertical flow. The vertical anisotropy was adjusted to provide a better match of vertical gradients. This change reduces the vertical interaction between the shallow and deep plumes.

The local appearance of high concentrations in the shallow zone is due to the partial penetration of the former borrow pit into the second model layer. A composite conductivity is assigned to the cells in layer 2 that contain the borrow pit. This very high conductivity causes a locally high leakage to be computed. The implication is an artificially high connectivity between the borrow pit and the Biscayne aquifer. Likewise, this has been corrected in the model. Again, because the remediation time is determined by contaminants in the deeper zone, little difference in the answers is anticipated.

Some diffusive movement is unavoidable in a discrete numerical approximation. This model has cells with very high concentrations adjacent to cells with very low concentrations. This is an issue of model resolution. Because the primary questions were initially related to plan-view flow directions, we elected to devote most of the resolution to the lateral discretization. This small, numerical spreading could be lessened with additional layers in the model. But the model *representation of the deeper aquifer would change little and only the lower concentrations in the shallow zone would be affected.*

Golder also notes a lack of southerly migration of the general plume. Careful inspection of the deeper plumes shows movement to the south and east over the first 6 years. After this time, decay causes an apparent receding of the plume because the 1 part per billion (ppb) total volatile organic compound (TVOC) contour is moving northward. The generally slow movement of the plume is attributable to the relatively high effective porosity (10 percent) and a slow movement of contaminants from the shallow zone to the deep zone near FPR. The near-surface source of contamination from FPR was not included in the simulations, but there is contamination in the shallow zone (Figure 1 of the Technical Memorandum). Because there is very little movement in the shallow zone and a slight downward flow at FPR, the remaining groundwater contaminants at 60 feet below ground surface provide a "source" of contaminants for the lower layers. It is this process that motivated the location of two 50-gallons per minute wells near FPR.

4.1.2 Peele-Dixie Wellfield Contamination

In addition to comments that the groundwater model cannot be used to reliably show a hydraulic connection between the FPR facility and Peele-Dixie Wellfield, the PRPs contend that other factors such as contaminant distribution and degradation, the North New River Canal, and other sources of contamination preclude the possibility that the FPR facility contaminated the Peele-Dixie Wellfield.

4.1.2.1 Contaminant Distribution and Degradation

The PRPs contend that the distribution and degradation of contaminants at the site preclude the possible contamination of the Peele-Dixie Wellfield by FPR. Specifically, the PRPs reason that groundwater data collected thus far has shown only the presence of parent compounds (i.e., perchloroethene [PCE] and trichloroethene [TCE]) at the FPR facility and in the wellfield. They state that all parent compounds are degraded on site and, therefore, any parent compound in the wellfield must be from a different source.

EPA Response: *EPA disagrees with the PRPs' analysis of the distribution and degradation of the parent compounds at the FPR facility and wellfield. EPA believes that the contaminant distribution and degradation is indicative of differing degradation rates due to changes in water chemistry. EPA believes that distribution of the volatile organic compounds (VOCs) contamination at the FPR facility show that the contaminants migrated downward into the more transmissive zones of the aquifer. After reaching the more transmissive zone, EPA believes that the PCE and TCE parent compounds were able to migrate rapidly into to the Peele-Dixie Wellfield. EPA believes that the data support the degradation of the parents into daughter products, which include dichloroethene (DCE) and vinyl chloride in the vicinity of the facility and northward up to the wellfield. Once in the wellfield, however, EPA believes that the aquifer* *conditions change to a more oxygenated environment, retarding the breakdown of the parent compounds. Parent compounds have remained at the facility due to the extremely high initial contaminant levels and at the wellfield due to the more oxygenated environment expected during the historical unrestricted pumping of the wellfield.*

4.1.2.2 North New River Canal

The PRP Group also contends that conditions at the North New River Canal would have prevented the migration of contaminants from FPR to the Peele-Dixie Wellfield. The PRPs reason that due to the fact that the portion of the canal between the wellfield and FPR facility is saline, if pumping at the wellfield had been such that a gradient was induced south of the wellfield, the wellfield would have been impacted by saltwater intrusion prior to mobilizing contaminants at the FPR facility.

EPA Response: *EPA disagrees with the PRPs' evaluation of the influence of the North New River Canal on groundwater movement in the vicinity of the wellfield. First, measurements of groundwater elevations have generally shown that downstream of Sewell Lock, in the vicinity of the wellfield, groundwater discharges to the canal. This is consistent with the upward vertical gradients measured during the remedial investigation (RI). Second, due to the age of the canal, significant amounts of sedimentation and vegetative growth have reduced the hydraulic communication between the canal and groundwater. Finally, the RI report showed that contaminants migrated into the highly transmissive zones of the Biscayne aquifer, spreading out laterally through the lower portions of the aquifer. Since pumping of the wellfield was from the lower transmissive zones of the aquifer, contaminants would have been expected to have migrated with the groundwater through the highly transmissive zones of the aquifer before inducing a downward gradient into less transmissive zones of the aquifer. Clearly, the PRPs' analysis is inconsistent with the hydrogeologic conditions specific to the site.*

4.1.2.3 Historical Potentiometric Maps

Comments from the PRPs suggest that there are no potentiometric maps that show the groundwater gradient induced by the wellfield pumping extending southward, beyond the North New River Canal. The PRPs suggest that this is evidence that the pumping at the Peele-Dixie Wellfield never created a gradient that extended beyond one-half mile from the wellfield.

EPA Response: *EPA disagrees with the PRPs' interpretation of the historical potentiometric maps. EPA's review of the historical groundwater monitoring data and associated potentiometric maps indicates that the amount of historical groundwater monitoring data north and south of the canal is limited. Furthermore, discussions with the SFWMD indicate that during the development of potentiometric maps, surface water features such as the North New River Canal were contoured as a groundwater divide, based on convention, and may not accurately reflect the actual site conditions. The influence of a canal on groundwater movement would need to be assessed on a site-specific basis.*

4.1.2.4 Other Sources

Why Focus on FPR?

The PRPs have consistently questioned why EPA focused its efforts on the FPR Site as a source of contamination to the Peele-Dixie Wellfield, when the FPR Site was not identified as a likely source of contamination during the initial investigation of the wellfield. The PRPs question why EPA changed its focus on the source of contamination of the wellfield in view of Florida Department of Environmental Regulation's (FDER) conclusion that the source of the wellfield contamination was in proximity to PW-18. The PRPs also believe that EPA mischaracterized the contamination in the 21st Manor Dump and that the dump may be the source. According to BB&L's comments, EPA's investigation of the dump was too shallow to have located potential releases of a dense nonaqueous-phase liquid (DNAPL) that could have caused the wellfield contamination. As part of its evaluation of the source of the wellfield contamination, BB&L presents a figure denoting the probable location of the source (Figure 2-4, BB&L, 1998).

Finally, ARCADIS Geraghty & Miller (AGM) theorized that due to the presence of PCE in the wellfield and lack of PCE at depth, there must have been a release of PCE in the wellfield. According to AGM, PCE, a well-known parent compound, was detected at concentrations between 1.3 to 1.91 micrograms per liter (µg/L). However, the maximum PCE concentration ever reported at FPR was 260 µg/L, at a maximum depth of 45 feet. AGM believes that the absence of contamination at depth below FPR is evidence that there could not have been any migration of PCE from FPR to the wellfield.

EPA Response: *EPA disagrees with the PRPs' premise that because the FPR Site was not initially considered as a source of groundwater during the investigation of the Peele-Dixie Wellfield, it is now disqualified from consideration. Likewise, EPA disagrees with the PRPs' premise that because a site was initially considered as a source of contamination, it cannot later be ruled out as a contaminant source. This type of logic defies all principles regarding sound scientific reasoning.*

EPA initially considered the 21st Manor Dump to be the source of the wellfield contamination primarily due to its proximity to production well PD-18. To evaluate the dump as a potential source of contamination, an extensive subsurface soil sampling investigation was conducted that included the installation of 25 soil borings that penetrated the full thickness of the dump. None of the samples collected indicated the presence of chlorinated VOCs (CVOCs). Hence, the dump was ruled out as a source of contamination. In spite of these data that overwhelmingly show the absence of any CVOCs in the soil , BB&L suggests that there may have been a DNAPL release at the dump that could have somehow avoided leaving residual contamination within the soil, but migrated downward out of the dump, and contaminated the production zone in the wellfield. While it is true that DNAPL releases are difficult to detect using traditional soil-sampling techniques, it is unlikely that among the 25 borings with multiple collection depths in each borehole, no CVOCs would have been detected had waste been present at levels high *enough to constitute a DNAPL. Moreover, groundwater contaminant levels in the wellfield do not even approach the threshold value of 1 percent of the compound solubility that would suggest the presence of a DNAPL. Concentrations of 1,2-DCE detected in the wellfield never exceeded 300 μg/L, which is more than 100 times less than 1 percent of the solubility of 1,2-DCE.*

If the dump (or other locations in the wellfield) were the source of contamination in the wellfield and represented an ongoing source of contamination (for which there has been no removal of the alleged source), then there is no known explanation for the dramatic decrease in CVOCs in the wellfield in only 5 years of pumping. Total CVOCs have dropped from 300 to 10 ppb in less than 5 years. This type of reduction in CVOCs in such a short period of time is not consistent with a groundwater containment system. Only two wells are being pumped to hydraulically contain the water in the southern part of the wellfield. Clearly, the system in operation is not designed as an efficient groundwater recovery system intended to restore the aquifer. The most plausible explanation for the rapid removal of CVOCs is that the pumping has removed remnant CVOC contamination that was released from a distant source. If there were still a source (i.e., DNAPL) present in the dump, clearly there would not been such significant removal of the CVOCs in such a short period of time.

Finally, AGM's theory that there may have been a release of PCE in the wellfield is unsupported. During its initial investigation of the wellfield contamination, EPA considered the possibility of a release of PCE from possible equipment maintenance and cleaning. The city of Fort Lauderdale provided EPA with a summary of its well maintenance practices. The city documented that minor well servicing that may have included pump lubrication would have been conducted at the wellhead, while major pump repairs would have been made at the city's central shop.

The city advised EPA that at no time would it have used CVOC degreasers at the wellfield. The concentrations of PCE (i.e., 1.3 and 1.91 μg/L) detected in the wellfield are too low to suggest the possibility of a source of CVOCs, particularly when contrasted with FRP, where source concentrations were on the order of hundred of millions parts per million. With regard to the absence of PCE at depth, it is plausible that the PCE concentrations observed in the wellfield at shallower depths are the remnants from the initial influx of contaminant from FPR and, due to differences in water chemistry in the upper and lower zones of the aquifer, may not have been completely degraded to DCE.

Geography and Hydrogeology Dictate Other Sources

One of the PRPs contends that as a result of the urbanization of the Site area and highly transmissive nature of the aquifer, the aquifer is acutely sensitive to the activities conducted above it and, as a result, must have been contaminated by additional sources other than just FPR. The PRP asserts that to believe otherwise ignores this basic fact.

EPA Response: *EPA disagrees with this PRP's assertion that because an area is industrialized, by definition it must include a concentrated source of CVOC contamination. While industrialized areas as a rule tend to have higher concentrations of metals and total petroleum hydrocarbon contamination, a concentrated source of CVOCs of the magnitude to have impacted the water quality at depths of 140 feet would have to have been from a significant release, not from deminimus releases consistent with the specified uses of the chemical.*

The PRP is correct, however, that due to the unique hydrologic properties of the aquifer, the aquifer is acutely sensitive to the activities conducted above it. This is best illustrated by a comparison of the shallow and deep contaminant data at FPR and the other waste oil recycling facilities in the area. The following table summarizes the maximum CVOCs detected in wells screened near the water table and at an approximate depth of 50 to 60 feet below land surface. As the commenter points out, there is rapid penetration of contaminants due to the unique hydrologic properties of the Biscayne aquifer and, as a result, the water quality of the aquifer is acutely sensitive to the activities conducted above it. Clearly, FPR represents a significant source of CVOCs that has greatly impacted the underlying groundwater. Conversely, evidence from the other oil facilities indicate they do not represent a significant source of contamination at the surface and, therefore, have not impacted the underlying groundwater.

Selected Maximum Chlorinated VOCs
Florida Petroleum Reprocessors and
Other Nearby Oil Facilities

Contaminant	*Florida Petroleum Reprocessors*		*Perma-Fix*[1]	*Cramer-Maurer Oil*	*Neff Oil*	*Petroleum Management, Inc.*
	Water Table	*Inter-mediate*[2]	*Water Table*			*Intermediate*[3]
PCE	260	ND	ND/ND	ND	ND	ND
TCE	100,000	14,000	1/ND	ND	ND	4
1,2-DCE (total)	270,000	40,600	5/ND	3	1	ND
Vinyl Chloride	18,000	1,400	20/177	ND	43	ND

Notes:
1 - First value is EPA data collected in January 1998 as part of RI. Second value is from Perma-Fix sampling of its facility in March 1997.
2 - Data from EPATW-1S, screened 50 to 60 feet below land surface.
3 - Data representative of wells EPA-15S and EPA-18S, screened from approximately 50 to 60 feet below land surface.

Other Oil/Industrial Facilities

The PRPs have identified numerous facilities in the vicinity of the FPR Site that they believed to have caused the plume of contamination in the Peele-Dixie wellfield or plumes of contamination south of the FPR Site. According to the PRP Group, there is a myriad of evidence of other, more probable sources of contamination in the CVOC plume area mapped by EPA than the FPR Site. The PRP Group alleges that EPA has ignored this information and done little to investigate these other sources of contamination.

Additional sources of contamination identified by the PRPs includes Perma-Fix, Petroleum Management, Inc., Neff-Oil, Cramer Maurer Oil Pit, Atlas Waste Magic, Wheelabrator South Broward, and Davie Concrete. The PRPs allege that the first four waste oil facilities are likely candidates for the VOCs, and that Neff-Oil and Cramer-Maurer were larger in scope than the operations at FPR. The PRPs obtained records from the state and county on several of the facilities and summarized some of the data in their comments. They also provided EPA with a summary of the state's and county's enforcement history with several of the sites. According to the PRPs, these facilities have not been thoroughly investigated and are sources of contamination causing the two plumes they delineated south of the FPR Site.

In addition to the discussion of these facilities, the PRPs complied a list of 78 sites within a 1-mile radius of the FRP Site that includes hazardous waste facilities and leaking underground storage facilities. The PRPs contend that remediation of the Biscayne aquifer can only succeed if EPA stops attributing the contamination to the FPR Site and addresses these multiple sources of contamination.

EPA Response: *EPA disagrees with the PRPs' assertion that the Agency has done nothing to investigate the possibility of other sources of groundwater contamination in proximity to the FPR Site and the Peele-Dixie Wellfield. To suggest otherwise is simply a false characterization of the facts. A consultant for one of the PRPs called attention during the Proposed Plan meeting held in June 2000 to the Start's Junkyard Site and 28 other potential sources located in an L-shape around the wellfield where he claimed faulty sampling collection occurred.*

During the initial investigation of the Peele-Dixie Wellfield contamination and the subsequent FPR RI, EPA investigated numerous other sites as possible sources of contamination. This investigation included a historical aerial survey of the area, review of State and County records, and, in several cases, the collection of samples from the other facilities. The additional sources considered are as follows:

- *Broward County 21st Manor Dump*
- *Peele-Dixie Wellfield*
- *Residence South of Wellfield*
- *Palm Trucking*
- *Atlas Waste Magic*

- *Complete Well Point*
- *Perma-Fix*
- *Petroleum Management, Inc.*
- *Neff Oil*
- *Cramer-Maurer Oil Pits*
- *Wheelabrator, Inc.*
- *Davie Concrete.*

EPA investigated and ruled out each of these facilities as potential sources of contamination of the same magnitude as FPR and which could have been large enough to have impacted the wellfield. The data EPA collected are included in the RI report.

EPA rejects a suggestion that the 78 businesses denoted within a 1-mile radius of the FPR Site are indeed sources of contamination to the Peele-Dixie Wellfield that should be sampled extensively before a remedy can be selected. There are no data to support this view or anything to suggest that future sampling is warranted.

4.1.2.5 Faulty Sampling Methods

At the Proposed Plan public meeting held in June 2000, a consultant to one of the PRPs questioned the early sampling data used in the USACE groundwater modeling data, saying that contaminant concentrations were elevated from faulty well drilling methods. He said that DNAPL was found in deep aquifers from samples taken from contaminated wells, but that current samples collected from wells installed with better drilling methods showed that DNAPL has disappeared.

EPA Response: *Mr. Bauch repeatedly has suggested that there is some other cause to the contamination other than the FPR Superfund Site. He repeatedly has attempted to discredit any finding that are contrary to his initial characterization of the FPR facility on behalf of the facility owner. Over the years, he has faulted EPA's investigation of the FPR facility, suggesting that the data are faulty either as a result of improper well installation or as a result of constructing the wells with polyvinyl chloride. He also has suggested that the contamination is the result of releases from a former facility south of FPR known as Complete Wellpoint. According to Mr. Bauch, Complete Wellpoint stored vinyl chloride in an underground tank for fabrication of polyvinyl chloride. As EPA has explained to Mr. Bauch in the past, all of these allegations are unfounded.*

EPA used standard well installation protocols and was very careful in the installation of wells and collection of subsurface soil samples. Hundreds of samples have been collected from this facility over the years by multiple contractors for both EPA and the PRPs. It is unreasonable to assume that all of the sampled were collected improperly or that the data are faulty.

With regard to the Complete Wellpoint facility, records show that the facility fabricated groundwater extraction systems at construction sites in order to dewater excavations. The only underground storage tank was for diesel fuel. Not only did the fabrication occur at the construction site, but vinyl chloride is not a constituent of the solvent used to weld PVC pipe. Welding solvents commonly contain a mixture of two or more of the following compounds: tetrahydrofuran, methyl ethyl ketone, methyl isobutyl ketone, cyclohexanone, and dimethylformamide (EPA, Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, EPA/600/4-89/034, March 1991).

4.1.3 Alternative Cleanup Plan

Although the PRP Group states that it is not responsible for, nor affiliated with, contamination in the vicinity of the Peele-Dixie Wellfield, it suggests in its comments that EPA consider an alternative to the preferred remedy outlined in the Proposed Plan. The PRPs contend that there are no current risks to the wellfield and that selection of the preferred remedy would be inconsistent with the NCP. As an alternative, the PRPs suggest the implementation of a groundwater monitoring program to establish the maximum rate that the northern and southern portions of the wellfield can sustain without mobilizing the groundwater plume. The city then would be required to limit pumping to that rate until natural attenuation reduces contaminant levels in proximity to the wellfield and the levels no longer pose a threat to the wellfield through increased pumping. The PRPs believe that this approach "has the greatest probability of achieving the established remedial action objectives within a relatively short time frame, and certainly a greater probability than an untested, relatively complicated hydraulic barrier which has yet to be designed or built."

EPA Response: *EPA disagrees with the appropriateness of the PRPs' proposed remedial alternative. First, EPA believes that the statute and NCP are clear regarding the need to actively restore contaminated aquifers to their beneficial use as rapidly as possible, especially when a drinking water supply has been impacted or may be potentially threatened in the future. The use of MNA under these circumstances is inconsistent with the NCP and guidance. EPA believes that the statute and NCP provide a strong basis for the selection of a remedy that is designed to actively restore the aquifer to its beneficial use (i.e., maximum contaminant levels [MCL], MCL goals).*

EPA formerly evaluated pump-and-treat alternatives for the restoration of a significant portion of the groundwater plume, but after further analysis of the fate and transport of groundwater contaminants through groundwater modeling, EPA now believes that the requirements of public health protection and groundwater restoration can be achieved through a more focused effort of pumping and treating in the wellfield in combination with natural attenuation. Since groundwater modeling results suggest that MNA would be effective in treating much of the groundwater plume before downgradient drinking water supplies could be affected, EPA determined that the collection and treatment of water via the wellfield could cost-effectively protect the drinking water resource in the wellfield. The pump and treat system will be designed *to collect and treat contaminants from the northern portion of the plume that may enter the Peele-Dixie Wellfield.*

Finally, it is unclear as to have how the PRPs reason that monitored natural attenuation will be more effective in achieving the remedial action objectives in a shorter period of time than pumping and treating the groundwater. The PRPs' contention that the fact that the containment system has not been designed or built yet makes it inferior to monitored natural attenuation is also perplexing. Clearly, monitored natural attenuation cannot provide faster and more effective remediation of the groundwater and protection of the Peele-Dixie Wellfield than the collection and treatment of contaminated groundwater.

4.1.4 Alternative GW4 Remediation Cost Estimate

The PRPs contend that EPA severely underestimated the capital cost for construction and the long-term operation and maintenance cost for Alternative GW4. The PRPs suggest that the present worth cost for implementation of Alternative GW4 would be closer to 5.6 to 6.2 million dollars.

EPA Response: *EPA disagrees with the PRPs; analysis of the cost estimate for Alternative GW4. EPA's review of the PRPs' cost estimate indicates that they used discount factors of 3 percent and 5 percent, which is different than that specified in EPA's current guidance for calculating net present value. EPA's guidance for calculating net present value specifies the use of a discount factor of 7 percent. Based on the use of a 7 percent discount factor, the PRPs' cost estimate is $5,564,000, which is within the range of cost estimate precision specified in EPA's RI/FS guidance of plus 50 percent to minus 30 percent. Nevertheless, further review of the PRPs cost estimate indicates that some project costs seem excessive and nonsupportable, given the anticipated scope of work. For example, the PRPs have included contingencies totaling 65 percent of the total cost of construction. Use of a more reasonable contingency factor of 25 percent would decrease the PRPs' capital cost estimate by approximately $651,000.*

4.1.5 Remedial Alternative Specificity

On several occasions, the PRPs commented the remedial alternatives outline in the Proposed Plan lack the necessary degree of specificity for proper evaluation.

EPA Response: *EPA disagrees with the PRPs' comments that the alternatives outlined in the Proposed Plan lacked the necessary degree of specificity for proper evaluation. The Proposed Plan outlines the basic frame work of each remedial alternative. EPA believes that sufficient detail was provided not only to evaluate the differences among the remedial alternatives, but to develop an order of magnitude cost estimate for the alternatives. The PRPs seem to be seeking the level of detail that would normally be available after the completion of the remedial design.*

Furthermore, EPA is somewhat surprised by this comment, given the fact that two meetings were held with all of the stakeholders prior to the release of the Proposed Plan. At that time, EPA discussed the plans for the alternatives to be included in the Proposed Plan and provided everyone with an opportunity to comment on the proposed alternatives prior to the issuance of the Proposed Plan.

4.1.6 Alternative GW4 Not Cost-Effective

The PRP Group and FDOT provided comments on the lack of effect the wellfield protection component of the remedy had on the overall site remediation time. They noted that the overall remediation time for Alternatives GW3 and GW4 were both 15 years. The PRP Group and FDOT reasoned that since the overall remediation time was not decreased nor is the wellfield currently threatened, the additional cost for Alternative GW4 is not justified, and therefore cannot be considered cost-effective.

EPA Response: *EPA disagrees with the PRPs and FDOT's comments that Alternative GW4 is not cost-effective. Clearly the PRPs and FDOT misunderstood the reason for the development of Alternative GW4. The only difference between Alternative GW3 and GW4 is the protection of the Peele-Dixie Wellfield.*

EPA included this component in an attempt to address the requirement of Section 118 of CERCLA and to address the expectations in Part 300.430 of the NCP and the preamble to the NCP. Both CERCLA and the NCP are clear that in cases where Class I aquifers or groundwater within a wellhead protection area are threatened or potentially threatened by the release of hazardous substances, pollutants, or contaminants, or where contaminants have contaminated a drinking water supply, EPA expects to restore the groundwater to its beneficial use as rapidly as possible. In light of the requirements of CERCLA and the NCP, EPA could have supported the implementation of a groundwater restoration remedy. However, EPA chose to pursue a more measured approach that incorporated the potential risks of exposure based on the groundwater modeling predictions. Based on the groundwater modeling predictions, EPA concluded that the area at greatest risk from contamination by the FPR plume is the Peele-Dixie Wellfield.

Accordingly, EPA develop a cost-effective remedy (Alternative GW4) that focused on the protection of the wellfield and would enable the city to resume unrestricted use of the wellfield as rapidly as possible. One approach considered was the groundwater restoration of the northern portion of the FPR groundwater plume. Because of the millions of gallons of water that would have been required to be pumped, treated, and disposed of on a daily basis to restore the northern portion of the plume, EPA developed a more cost-effective alternative (GW4) that was predicated on the collection and treatment of contaminants that may enter the wellfield from the northern portion of the groundwater plume. EPA, therefore, selected Alternative GW4 on the basis that it was the best approach available, balancing issues regarding compliance with CERCLA and the NCP, cost, and potential risk.

4.1.7 Wellfield Groundwater Remedy Not Warranted

The PRPs contend that implementing a remedy for the Peele-Dixie Wellfield is not warranted or supportable under CERCLA, as there are no exceedances of MCLs or any threat to human health, welfare, or the environment.

EPA Response: *EPA disagrees with the PRPs' comment that the selection of a wellfield remedy is not supportable under CERCLA. Clearly, the PRPs have lost sight of the basis for a groundwater remedial action for this site. As stated previously, the FPR and secondary source area have released hazardous substances that have contaminated a large portion of a Class I, sole source, drinking water aquifer. The releases to the aqueous plume have also contaminated a drinking water supply and resulted in the closing of drinking water wells.*

Pursuant to CERCLA, Congress mandated that a higher priority be assigned to releases that have either contaminated a drinking water supply or resulted in the closing of water supply wells. Furthermore, the NCP and preamble is clear regarding EPA's expectation to restore drinking water aquifers to their beneficial use as rapidly as possible where releases have contaminated or threatened Class I aquifers or wellhead protection areas. Exceedances of MCLs in a wellfield or current risks to human health clearly are not criteria specified in CERCLA or the NCP for taking an action. EPA's mission is to protect human health. Arguably, if EPA were to allow contaminants to go unchecked until they contaminate a drinking water supply, or if people are actually exposed to contaminated water, EPA will have failed in its mission of protecting human health.

EPA, therefore, selected Alternative GW4 has a cost-effective alternative to address the area at greatest potential risk. EPA felt that this would be a reasonable alternative to the presumptive remedial approach of pumping and treating large quantities of water over extended periods of time to restore contaminated aquifers to their beneficial use.

4.2 Miami-Dade County

Miami-Dade County submitted comments that restated the Group's position that there is no evidence that releases from the FPR facility impacted the Peele-Dixie Wellfield, and as a result, EPA should not target the "deep-pockets" of the Group for the cleanup of the wellfield.

EPA Response: *Over the past several years, EPA has communicated with the PRP Group at numerous meetings and in EPA documents that it disagrees with the Group's assessment that releases from the FPR facility have not impacted the Peele-Dixie Wellfield. Furthermore, this issue of whether or not the FPR facility impacted the Peele-Dixie Wellfield is one of potential liability, not remedy selection.*

Based on the criteria set forth in the NCP and CERCLA, EPA is supposed to give a high priority to the protection of drinking water supplies and groundwater resources currently threatened or *that may be threatened in the future by contaminants. EPA made its remedy selection on the fact that contaminants have been released into the Biscayne aquifer, a Class I aquifer, that also has received "Sole Source" designation. Depending on the interpretation of the data, the release has either migrated into or is in proximity to a wellhead protection area. The nature and extent of the groundwater plume documented during the RI and its threat to the Peele-Dixie Wellfield cannot be disputed. Likewise with comments from FDOT, issues raised by Miami-Dade County and the PRP Group regarding impact of releases from the FPR facility on the Peele-Dixie wellfield relate to potential liability and future settlement with the PRPs to perform the work, not remedy selection.*

While EPA is hopeful that it will reach a settlement with the PRPs to implement the ROD, statutory or regulatory requirements for remedy selection are not predicated on the acceptability or potential for implementation of the remedy by the PRPs. This is consistent with the Agency's "enforcement first policy." The issue of whether or not the FPR facility impacted the Peele-Dixie Wellfield should be addressed more appropriately during settlement discussions for the remedial design/remedial action.

4.3 Florida Department of Transportation

The FDOT submitted comments relating to EPA's belief that there is a secondary source along the Interstate-595 corridor that has commingled with the larger groundwater plume emanating from FPR. FDOT contends that the contamination is not the result of either of the former operations on the property known as Starta's Junkyard or Motor City Auto Parts, but rather is the result of the upwelling of groundwater contaminants that have migrated from the FPR facility. FDOT primarily cites references in the 1998 RI report by Bechtel Environmental, Inc. of vertical upwelling of groundwater in the vicinity of the I-595 corridor as the basis for the Department's assertion that there is no secondary source area. FDOT also cites a reference in the RI report stating a thorough environmental survey of the I-595 corridor conducted by FDOT did not find any potential sources of contamination.

EPA Response: *EPA disagrees with FDOT's assertion that there is not a secondary source of groundwater contamination along the I-595 corridor. EPA believes that when viewed as a whole, the data is compelling for a secondary source of groundwater contamination that has contributed to the contamination of the Peele-Dixie Wellfield.*

EPA believes that the most compelling line of evidence is the nature and distribution of contaminants in the groundwater plume and the geochemical data. A brief summary of the major points that EPA relied on in its assessment of the secondary source area follows:

- *There is an increasing trend in contaminant levels in a downgradient direction from the wellfield southward. Normally, contaminant concentrations decrease with migration due to attenuation, not increase.*

- *Groundwater monitoring of the area for many years has shown consistently a localized area of higher contaminant levels in the area of the northbound off-ramp from the Turnpike to I-595.*

- *This area of higher contamination is consistent with the location on aerial photographs of the former Starta's Junkyard and a subsequent business, Motor City Auto Parts. Reclamation of auto parts for resale may have required that the parts be degreased, which could have been done with chlorinated solvents such as TCE or trichloroethane. Aerial photographs and interviews with former neighbors and operators confirm the presence of excavations at the property that were backfilled, in part, with junk cars.*

- *Chloromethane was detected in wells in proximity to the secondary source area and at the FPR facility, but not in wells between the two areas. This is consistent with the very short half-life (i.e., 43 days) of chloromethane and the 2,500-foot distance between the two areas. It is unlikely that chloromethane could have migrated this distance without degrading, strongly suggesting the presence of another source.*

- *Geochemical data collected from the secondary source area reveal elevated levels of Cl^-, SO_4^{-}, and Na^+, likely reflecting the influence of fill material placed in backfill excavation. If groundwater were flowing upward from the deep zone of the shallow zone, the net chemical effect would be a dilution of the ionic concentrations in the shallow zone based on significantly lower concentrations of these constituents in the deeper groundwater. The distinct geochemistry of the shallow groundwater implies that much more concentrated (ionically) groundwater also must be contributing groundwater to the shallow zone, or the chemistry of the shallow zone would be diluted and more closely resemble the deep zone groundwater.*

With regard to the issue of the presence of the groundwater contamination being the result of an upwelling of contaminants from deeper zones, references from the RI report were taken out of context. The RI report was written objectively and tried to offer other possible explanations to the contamination. The report noted the presence of upwelling in the vicinity of the canal as another possible explanation. However, the report also noted that upwelling of the groundwater contaminants in the vicinity of the I-595 corridor cannot account for the distribution of chloromethane and geochemical parameters.

FDOT also cites references in the RI report that indicate that the Department conducted extensive environmental surveys of the area prior to the acquisition of the property, suggesting that if the property were contaminated, it would have been discovered during the property acquisition. While this may appear to be the case from an initial review of the file material, a more detailed review of the files and discussions with a former owner, state officials, and neighboring business owners familiar with the acquisition of the property for the construction of I-595 indicate that this was not the case for the following reasons.

- *Discussions with FDEP indicate that no formal environmental assessments were conducted during the acquisition of property for the construction of I-595 in the vicinity of the second source area. FDEP indicated that due to time constraints imposed by the construction schedule of I-595, environmental surveys were normally comprised of visual inspections of the property in an effort to identify obvious potential environmental problems (e.g., drums, tanks, etc.). Without a proper environmental assessment of the property that included the collection of numerous soil and groundwater samples, FDOT could not have known the environmental condition of the property.*

- *Discussions with FDOT confirm that while geotechnical data were collected to design the Interstate, no environmental samples were collected from the suspected secondary source area prior to the construction of I-595. This was confirmed by FDOT during the FPR Proposed Plan public meeting held on June 27, 2000.*

- *Discussions with the former property owner indicate that FDOT tried to devalue the price of the property due to environmental problems.*

While EPA agrees with FDOT that there is no conclusive evidence that Starta's Junkyard or Motor City Auto Parts were the cause of the contamination, EPA does believe that there is compelling data and records that show the presence of a secondary source of groundwater contamination in the vicinity of the off-ramp from the Turnpike to I-595. The former location of Starta's Junkyard and Motor City Auto Parts most closely coincides with the location of the secondary source area. Whether or not this former property is the actual source of contamination can only be determined from a thorough investigation of this property through the installation of numerous soil borings, installation of monitoring wells, and the collection of soil and groundwater samples.

It is critical to note that the issue of whether or not the former Starta's Junkyard or Motor City Auto Parts are the source of the secondary plume of groundwater contamination relates only to potential liability. This issue does not relate to remedy selection. EPA based its remedy selection on the presence of groundwater contaminants at levels that significantly exceed federal and state MCLs in a Class I aquifer that also has been designated a sole-source drinking water aquifer. The location of the plume also is within a wellhead protection area.

Furthermore, the remedy selected by EPA does not require the full characterization of the secondary source area, since it is within the boundary of the area of remediation already required for the remediation of the FPR Site. EPA tried to avoid the characterization of the former Starta's Junkyard property due to: (1) the current location of the property underneath the eastbound lane of I-595 and the northbound Turnpike exit ramp; (2) the costs and physical hazards of conducting a large-scale environmental assessment in this portion of the Interstate; and(3) the absence of a need to perform the investigation for remedy selection. Additional source characterization may be required at a later date, however, for the purposes of allocating the cost of the cleanup.